Rockwell International
Aerospace Operations
Rocky Flats Plant

Environmental Assessment Report for High Priority Sites

(881 Hillside Area)

U.S. Department of Energy
Rocky Flats Plant
Golden, Colorado

10 February, 1989

REVIEWED FOR CLASSIFICATION/UCNI
By [signature]
Date 2/24/92

ADMIN RECORD

A-OU01-000299

SUMMARY

Pursuant to a Compliance Agreement between the United States Environmental Protection Agency, the United States Department of Energy, and the Colorado Department of Health, a series of site characterizations for locations at the Rocky Flats Plant identified four areas for environmental contamination which, because they involved elevated concentrations of volatile organic compounds in groundwater and the proximity to surface drainage, where classified as High Priority Sites. Elevated levels of certain inorganic chemicals were also identified in the groundwater although current background data is not sufficient to adequately determine whether those levels are within the range of natural background or are due to historic plant operations. One of these areas is the 881 Hillside Area. The contamination at this site does not create any health risks at this time, but the possibility of future off-site migration or loss of institutional control could cause risks to members of the public or to the environment. Characterization of the site and selection of the proposed alternative are being pursued according to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Remedial Investigation/Feasibility Study (RI/FS) process. As determined in Appendix 1 of the Feasibility Study Report for the 881 Hillside area, most of the potential risks involve organic solvents in the alluvial groundwater although the dissolved inorganic chemicals could also cause health risks in the future.

The proposed remedial action (proposed action) is to capture the groundwater at the 881 Hillside, treat it to remove the volatile organic chemicals, and return it to the alluvial groundwater as described below. Facilities are also included for treatment to remove dissolved inorganic materials. The principal environmental benefit derived from this action is to remove the hazardous chemicals identified in the groundwater to prevent eventual release into the unrestricted environment.

The proposed action includes the installation of an extraction pumping well, french drain, reinjection trench, collection tanks, and a treatment facility using an ultraviolet light/peroxide process to remove the volatile organic chemicals and ion exchange resin columns to remove dissolved inorganic chemicals. During installation, construction will cause temporary negative

impacts on the environment such as topographical disturbances during excavation, interruption of the normal surface run-off or groundwater flow for the installation of the french drain and re-injection trench, and possible low level airborne releases of volatile organic chemicals during excavations. These impacts are not extensive, and environmental recovery will not be difficult. Installation and operational activities as well as possible credible accidents may cause the release of some contaminants to the air. The health risks to workers and the general public from the potential exposure to these contaminants are assessed in this document and are insignificant. No transportation of materials classified as hazardous is required by the proposed action. Transportation of equipment and materials for construction and operation of the proposed action faciliities will be limited and pose no significant environmental impacts or risks.

Most of the alternatives to the proposed action involve increased environmental impacts but fail to offer any long-term benefits beyond those provided by the proposed action. While the "no action" alternative has less immediate environmental impact, the probability of non-compliance with environmental statutes and regulations makes this alternative an unreasonable one.

A Remedial Investigation Report for the High Priority Sites (RI) at Rocky Flats (RI) was submitted to EPA and the Colorado Department of Health (CDH) on July 1, 1987, in accordance with the schedule set forth in the Compliance Agreement. Results of additional drilling and responses to EPA and CDH comments on the July report have been incorporated into the final draft Remedial Investigation Report, submitted to the EPA and the CDH on March 1, 1988. The Report provides verification of the existence and location of the high priority waste disposal sites, a characterization of the sites, and an evaluation of the nature and extent of contamination.

A draft Feasibility Study Report for High Priority Sites (FS) was submitted to the EPA and the CDH on March 1, 1988. The FS includes proposed and assessed alternative remedial actions that would eliminate or control environmental contamination at the 881 Hillside Area.

As part of the RI/FS process, the need for gathering improved and expanded background characterization data was identified. The data collected during this process should provide information necessary to determine whether the levels of certain inorganic chemicals are within the range of natural background or if they may be due to previous activities at the 881 Hillside site.

To avoid delaying remediation until after the analysis of the additional background characterization data becomes available and yet remain consistent with the final remedial actions as determined when the additional background characterization data has been analyzed, interim action under CERCLA may be taken upon issuance of a Finding of No Significant Impact (FONSI). Such interim action under CERCLA would be the same as the proposed action in the draft FS with the addition of treatment to also remove the inorganic chemicals.

The attached Summary Table shows the relative environmental impacts of the various proposed alternatives discussed in the FS (Rockwell International, 1988a).

SUMMARY TABLE

	Proposed Action	Alternatives						
		No Action	Immobilization	Total Encapsulation	Source Well and Footing Drain	Well Array	Soil Flush	Partial Excavation
Offsite Transportation								
Construction (truckloads)	520	0	71	460	275	280	802	925
Operation (truckloads/yr)	2-3	none	none	none	2-3	2-3	2-4	2-3
Contaminated Materials (truckloads)	none	none	none	none	none	none	none	200
Environmental Impact of Remedial Action								
Excavation	~7400 yd^3	none	none	none	none	none	~11,600 yd^3	10,300 yd^3
Well drilling	1	none	460	2	1	166	1	1
Topographical deformation (permanent)	none	none	2-3'	none	none	none	hillside terrace	none
Endangered Species Impacts	none	none	none	none	none	none	none	none
Cultural Impact of Remedial Action								
Resource Comsumption	small	negligible	less than proposed action	small	small	small	small but greater than proposed action	small but greater than proposed action
Archaeological Impacts	none	none	none	none	none	none	none	none
Wetlands Impacts	none	none	none	none	none	none	none	none
Long Term Considerations								
Remedial Action Period (Institutional Control)	~30 yrs	>30 yrs	0	>30 yrs	~30 yrs	~30 yrs	<30 yrs	<<30 yrs
VOC Contaminant Removal	yes	no	no	limited	yes	yes	yes	yes
VOC Contaminant Destruction	yes	no	no	no	yes	yes	yes	limited
Inorganic Contaminant Removal	no*	no	no	no	no	no	no	no

* Interim action taken under CERCLA will add inorganic compound removal until such time as background characterization determines the levels represent background or the water meets applicable standards for dissolved inorganic material without treatment.

SUMMARY TABLE

	Proposed Action	Alternatives						
		No Action	Total Immobilization	Encapsulation	Source Well and Footing Drain	Well Array	Soil Flush	Partial Excavation
Exposure of Worker's Construction	Negligible dermal exposure to contaminated soils in trench; trace VOC vapor exposure near excavations.	none	Negligible dermal exposure to soils and liquids from drilling operations.	none	none	Similar but slightly higher risks as for proposed action	Exposure risk similar to proposed action; add'l excavation adds to ordinary const. accident risks.	Substantially higher dermal & inhalation exposures over proposed action.
Routine	Trace VOC vapor exposure while in building, 2 hr/day	none	none	Routine dewatering could result in negligible dermal and inhalation exposures to VOCs.	Similar risks as proposed action.	Similar but slightly higher risks as for proposed action.	Similar risks as proposed action.	Similar lower risks as proposed action.
Accident	Contaminated water and hydrogen peroxide dermal exposure w/ negligible result. Trace VOC vapor inhalation w/ negligible impact.	none	none	Negligible risk of dermal or inhalation exposures to VOCs through transport spills of contaminated waters is vastly outweighed by truck impact risks.	Similar but slightly lower risks as prosposed action.	Similar risks as proposed action.	Similar risks as proposed action.	Similar lower risks as proposed action.
Exposure of General Public Construction	negligible truck exhausts	potential none	negligible truck exhausts	negligible truck exhausts	negligible truck exhausts	negligible truck exhausts	negligible truck exhausts	negligible truck exhausts
Routine	none	future release risk	none	future release risk	none	none	none	none
Accident	none	none	none	none	none	none	none	none
Cumulative Impacts to RFP Site	small	none**	small	small	small	small	small but greater than proposed action	small but greater than proposed action

** No direct impacts, but resutls of inaction may lead to eventual conditions having a great impact on the site.

1.0 INTRODUCTION

Rocky Flats Plant is a federally-owned, contractor-operated facility whose primary mission is the research, development, and manufacture of nuclear weapon components. The complex occupies 6,550 acres on a high plateau in northwest Jefferson County, Colorado, sixteen miles northwest of downtown Denver and ten miles south of downtown Boulder. Plant operations are confined to 400 of the Plant's 6,550 acres. 6,150 acres provide a federally-owned buffer zone surrounding the Plant. The Plant is operated by Rockwell International and administered by the Albuquerque Operations Office of the Department of Energy (DOE).

Rocky Flats Plant began operations in 1952. In the period from 1952 to the present, the plant has fabricated components consisting of plutonium, uranium, beryllium, and stainless steel and has pursued the related activities of chemical recovery and purification of process-produced transuranic radionuclides. Nuclear weapons research and development activities have involved chemistry, physics, materials technology, nuclear safety, and mechanical engineering.

From 1952 until 1972, portions of the 881 Hillside Area were used as oil sludge pits, chemical burial sites, liquid disposal sites, solvent drum storage sites, and fire damage refuse disposal sites as well as a disposal area for potentially contaminated asphalt and soil. As a result of these past activities, the soil and groundwater have been contaminated with chemicals categorized as hazardous. These practices have been discontinued.

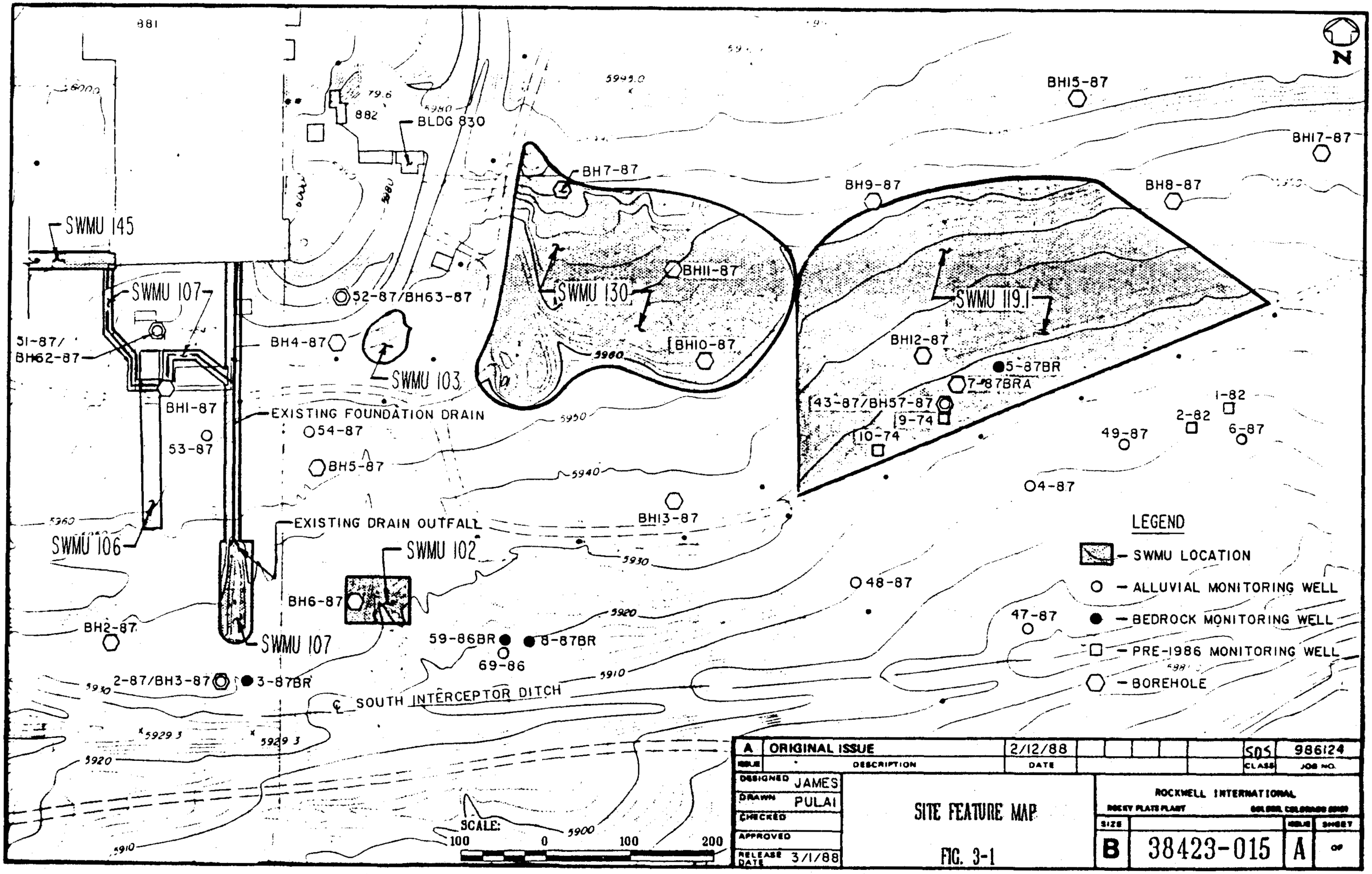
A comprehensive, phased program on site characterization, remedial investigations, feasibility studies, and remedial/corrective actions is in progress at the Rocky Flats Plant. These investigations are pursuant to the Compliance Agreement between the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the State of Colorado (CDH) dated July 31, 1986. The Agreement addresses hazardous and radioactive mixed waste management at the Rocky Flats Plant.

Hydrogeological and hydrogeochemical characterization on an installation-wide basis was performed at Rocky Flats in 1986 as part of the preparation of the Plant RCRA Part B Permit Application. Analysis of these data has identified four areas which are the most probable sources of environmental contamination, with each area containing several sites. These areas are the 881 Hillside Area, the 903 Pad, Mound, and the East Trenches Areas.

The 881 Hillside Area is considered the highest priority because of elevated concentrations of volatile organic compounds in the groundwater and the area's proximity to a surface drainage (see Figure 1-1). Subsequent analysis has indicated that of twelve Solid Waste Management Units (SWMUs) originally identified at the 881 Hillside Area, two have significant concentrations of organic chemical contamination. One (SWMU 119.1) is located around a drum storage area and the other (SWMU 107) is the outfall of the foundation drain for Building 881. The first site (SWMU 119.1) is a large undeveloped field southeast of Building 881 used for solvent storage from 1967-1972. The second site (SWMU 107) is currently beneath a loading dock at the south end of the building and was the site of an oil leak of unknown origin.

A Remedial Investigation Report for High Priority Sites (RI) at Rocky Flats was submitted to EPA and CDH on July 1, 1987, in accordance with the schedule set forth in the Compliance Agreement. Results of additional drilling and responses to EPA and CDH comments on the July report were incorporated into the final draft Remedial Investigation Report submitted to the EPA and the CDH on March 1, 1988. The Report provides verification of the existence and location of the high priority waste disposal sites, a characterization of the sites, and an evaluation of the nature and extent of contamination.

The Feasibility Study Report for High Priority Sites (FS) was submitted to the EPA and the CDH on March 1, 1988. This report concluded that remedial action was appropriate for the 881 Hillside Area, identified reasonable alternatives, and proposed a remedial action consisting of collection of water from the building foundation drain, a source well in SWMU 119.1, and a french drain located hydrologically downstream from sources of contamination. This collected water would be treated to remove organic compounds and returned to the groundwater.



881
882
BLDG 830
SWMU 145
SWMU 107
51-87/
BH62-87
BH1-87
53-87
SWMU 106
52-87/BH63-87
BH4-87
SWMU 103
EXISTING FOUNDATION DRAIN
54-87
BH5-87
EXISTING DRAIN OUTFALL
SWMU 102
BH6-87
SWMU 107
BH2-87
2-87/BH3-87
3-87BR
SOUTH INTERCEPTOR DITCH
59-86BR
8-87BR
69-86
BH7-87
SWMU 130
BH11-87
BH10-87
BH13-87
BH9-87
SWMU 119.1
BH12-87
5-87BR
7-87BRA
43-87/BH57-87
9-74
10-74
BH15-87
BH17-87
BH8-87
1-82
2-82
6-87
49-87
4-87
48-87
47-87
LEGEND
SWMU LOCATION
ALLUVIAL MONITORING WELL
BEDROCK MONITORING WELL
PRE-1986 MONITORING WELL
BOREHOLE
SCALE:
100 0 100 200
A ORIGINAL ISSUE 2/12/88
DESIGNED JAMES
DRAWN PULAI
CHECKED
APPROVED
RELEASE DATE 3/1/88
SITE FEATURE MAP
FIG. 3-1
SDS 986124
ROCKWELL INTERNATIONAL
ROCKY FLATS PLANT
B 38423-015 A

FIGURE 1-1.

Although elevated levels of certain inorganic chemicals were identified during the RI/FS process, current background data is not sufficient to determine if the levels are within the range of natural background for the area. Additional background characterization studies are being performed which will permit a better assessment of the nature of the inorganic constituent concentrations. In order to avoid delaying remediation until after the analysis of results of the background characterization studies, and yet remain consistent with the final remedial action, interim action under CERCLA will be taken upon issuance of a Finding of No Significant Impact (FONSI). The interim action under CERCLA will be the same as the proposed action in this report with the addition of treatment of the collected water to remove the inorganic chemicals. If the results of the background characterization studies indicate that the concentrations of inorganic chemicals are within background levels, or it is found that the effluent water meets applicable water standards, the treatment for removal of inorganic chemicals will be discontinued.

The sampling and analysis performed for the RI and FS indicated that none of the twelve SWMUs involved radiological conditions requiring remedial or corrective action. Subsequent investigation has indicated two SWMUs may have radiological conditions that may require special actions in addition to those in the proposed action or alternatives.

1. SWMU 119 - This SWMU may contain small, localized areas of elevated surface contamination. The response to this possibility is addressed in section 5.5.1 of this report.

2. SWMU 130 - Although core borings in this SWMU yielded no evidence of radiological contamination, a review of plant documentation has indicated that the area was used to dispose of uncontained waste contaminated with plutonium. This consisted of potentially contaminated material from three sources:

    1. Asphalt that was contaminated on the surface, seal-coated, removed and deposited at the 881 Hillside. (June, 1968)

2. Asphalt that was contaminated on the surface. An additional layer of asphalt was placed over the contaminated surface and then both layers removed and deposited at the 881 Hillside along with some soil from the area of the contaminated asphalt. (1969)

3. Sixty cubic yards of soil, taken from an area of known ground contamination, but which was declared clean following surveys by portable instrumentation. (June, 1972)

Additional boring samples will be taken in SWMU 130. Any additional remedial action to be taken in SWMU 130 will be based on the results of this additional sampling. Since there is no evidence of any ground or surface water contamination by this potential source, there should not be any direct impact on the proposed action or any of the alternatives. If any further action is indicated by the additional sampling, the analysis of any such actions will include the potential for cumulative effects of the additional remedial action plan.

The National Environmental Policy Act (NEPA) requires that "all agencies of the Federal Government shall . . . include in every recommendation or report on proposals for . . . major Federal actions significantly affecting the quality of the human environment, a detailed statement { EIS } . . ." (NEPA Title I, Section 102(2)). The purpose of this Environmental Assessment is to determine whether or not the proposed action is a major Federal action significantly affecting the quality of the human environment.

The Environmental Assessment is organized as follows:

2.0 Purpose, Need, and Scope
A description of why the remedial action is important as well as a description of the limits placed on the scope of the Environmental Assessment.

3.0 Description of the Proposed Action and Alternatives
A detailed description of the Proposed Action and brief description of the actions considered as alternatives to the proposed action.

4.0 Affected Environment

A description of the environmental conditions in the area affected by the proposed action and alternative actions

5.0 Environmental Effects of the Proposed Action

A detailed description of the expected environmental impacts due to the proposed action on such items as air quality, water quality, terrestrial impacts, and both short- and long-term land use impacts. Also discussed are potential exposures to hazardous materials of site workers and the general public as well as the health risks associated with those exposures. These include activities and transportation involved in installation of equipment required by the proposed action as well as during normal operation and operation under emergency situations. Also addressed in this section are the resources that would be involved in the action, especially those that would be irrevocably and irretrievably committed to the proposed action and the cumulative impacts when combined with other known activities at Rocky Flats Plant.

6.0 Environmental Effects of Alternatives

Brief discussion is presented for each of the alternatives analyzed in the FS (Rockwell International 1988a) which compares the impact of each alternative to the impacts of the Proposed Action. The analysis for each alternative compares impacts on environmental quality, personnel exposure, and transportation.

Appendix A - Risk Estimation Techniques

This appendix describes in detail the calculations performed to estimate exposures and risk estimates included in the body of the report.

Appendix B - Special Terms Used in the Report

This appendix includes definitions and explanations for certain terms and concepts used in the report including the calculation and presentation of risk estimates. Included in this appendix are explanations of contaminant, general public, hazardous chemical, institutional control, cancer risk, cancer potency factor, and Health Effects Criteria.

Appendix C - Source Concentrations

This appendix presents the estimated source concentrations and of details how average concentrations were derived.

Appendix D - Risks from Exposures during Installation.

This appendix presents the details of the computation of the risks associated with dermal exposures to workers during excavations and estimation of the levels of uranium contamination in air during removal of localized radioactive contamination.

Appendix E - References

Appendix F - List of Preparers and Reviewers

2.0 PURPOSE, NEED, AND SCOPE

2.1 BACKGROUND

As described in 1.0, a comprehensive program of site characterization remedial investigations, feasibility studies, and remedial/corrective actions is in progress at the Rocky Flats Plant. Subsequent analysis of the data identified four high priority areas as probable sources of environmental contamination, one of which is the 881 Hillside Area. The investigation of the twelve Solid Waste Management Units (SWMUs) on 881 Hillside became a high priority due to the high volatile organic compound concentrations found in the groundwater and the units' proximity to one of the surface drainages from the Plant. Detailed location, history, and contamination assessment information relating to the SWMUs appears in the Remedial Investigation Report on the 881 Hillside (Rockwell International 1988c) which is incorporated herein, and made a part hereof. Information on selection of preferred remedial action (including a risk assessment) may be found in the Feasibility Study Report on the 881 Hillside (Rockwell International, 1988a) which is incorporated herein, and made a part hereof.

2.2 PURPOSE

The purpose of the proposed action is to protect the health and safety of the public through minimizing the risks presented by the hazardous waste contamination. Applicable federal and state laws require that these areas be investigated and, if required, remediated through corrective action. Due consideration of the potential impacts resulting from the proposed action, as well as an assessment of reasonable alternatives, must be considered to be consistent with the requirements of the National Environmental Policy Act.

2.3 NEED

The need for the remedial action is demonstrated in the Remedial Investigation Report (RI) and the Feasibility Study Report on the 881 Hillside Area (FS). The reports present evidence of hazardous waste contamination at sites on the 881 Hillside. Table 2.1-1 lists the hazardous materials identified as indicator chemicals in the Risk Assessment (RA). The RA concludes that, due to the nature of some of the contaminants, a risk of migration of

Table 2.1-1

Indicator Chemical Concentrations

Indicator Chemical	Alluvial Groundwater (mg/l)		Soil (mg/kg)	
	Average	Maximum	Average	Maximum
Organics				
Bis-(2-ethylhexyl)phthalate	NR	NR	1.24	7.21
Carbon Tetrachloride	8.30 E-1*	2.80 E+1	8.00 E-3	8.00 E-3
1,2-Dichloroethane	5.06 E-1	1.60 E+1	8.00 E-3	1.00 E-2
1,1-Dichloroethene	3.78	4.80 E+1	8.00 E-3	8.00 E-3
t-1,2-Dichloroethene	1.25 E-1	5.07	8.00 E-3	1.80 E-2
Tetrachloroethene	1.09	1.32 E+1	1.30 E-2	1.90 E-1
Trichloroethene	4.15	7.20 E+1	1.10 E-2	1.50 E-1
Inorganics				
Nickel	8.00 E-2	4.38 E-1	1.30 E+1	7.10 E+1
Selenium	2.76 E-1	2.00	4.90 E-1	4.90 E-1
Strontium	1.00	2.42	6.60 E+1	2.09 E+2
Uranium (total)				
Groundwater	3.60 E-2 (22.5 pCi/l)[2]	1.13 E-1 (63.6 pCi/l)	NA	NA
From core borings	NA	NA	3.14 (1.85 pCi/gm)	6.73 (4.1 pCi/gm)
Surface soils[1]	NA	NA	264 pCi/gm	3030 pCi/gm
Plutonium				
Surface soils[1]	NA	NA	1.63 pCi/gm	4.8 pCi/gm

NR = Contaminant not reported above minimum detection limit in any on-site sample from this medium.

NA = Not Applicable

* 8.30 E-1 = 8.30×10^{-1} = 0.83

1 From Enclosure (1) to Rockwell letter 881HS-1 dated 9-1-88.

2 Total uranium expressed in radiological units.

both organic and inorganic chemicals exists. Current background data for radionuclides does not indicate any migration of radionuclides. Additional studies are being conducted to obtain a more complete characterization of background radionuclide levels. When the results of these studies become available, the 881 Hillside data will be reassessed. Plutonium does not migrate readily in soil and the radioactive contamination identified at the soil surface is of a chemical form not readily soluble in water (Krey, 1970). If migration were to occur, the organic and inorganic chemical contaminants might present a threat to the health and safety of the public some time in the future. The data indicates that to date there has been no migration of any contaminants off-site.

2.4 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

This Environmental Assessment (EA) is prepared pursuant to the National Environmental Policy Act (NEPA) of 1969, as implemented by regulations promulgated by the President's Council on Environmental Quality (CEQ) and DOE Guidelines. It is intended to provide sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement or a Finding of No Significant Impact for the proposed remedial action at the 881 Hillside Area. The following are examined:

1) The environmental impact of the proposed action, which consists of: collection of groundwater from identified sources, installation of a french drain, treatment of the groundwater, and return of the groundwater to the alluvium.

2) The environmental impact of the following alternatives:

   a) No action
   b) Immobilization
   c) Total encapsulation
   d) Source well and footing drain collection with treatment
   e) Comprehensive well array and treatment
   f) French drain and soil flushing
   g) French drain and partial excavation

The alternatives were selected to be representative of reasonable alternative actions as determined in the Feasibility Study Report for the 881 Hillside Area.

The scope of the assessment does not include evaluation of the existing operations at the Rocky Flats Plant nor subsequent remedial actions at other locations of the Rocky Flats Plant. The environmental impacts of plant operation were analyzed in the final Environmental Impact Statement (DOE, 1980). NEPA documentation for subsequent remedial actions at other locations of the Rocky Flats Plant will be provided in other reports. This assessment does not include assessment of the environmental impacts of operation of any hazardous waste site to which hazardous waste generated by the proposed action or any of the alternatives may be shipped.

3.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

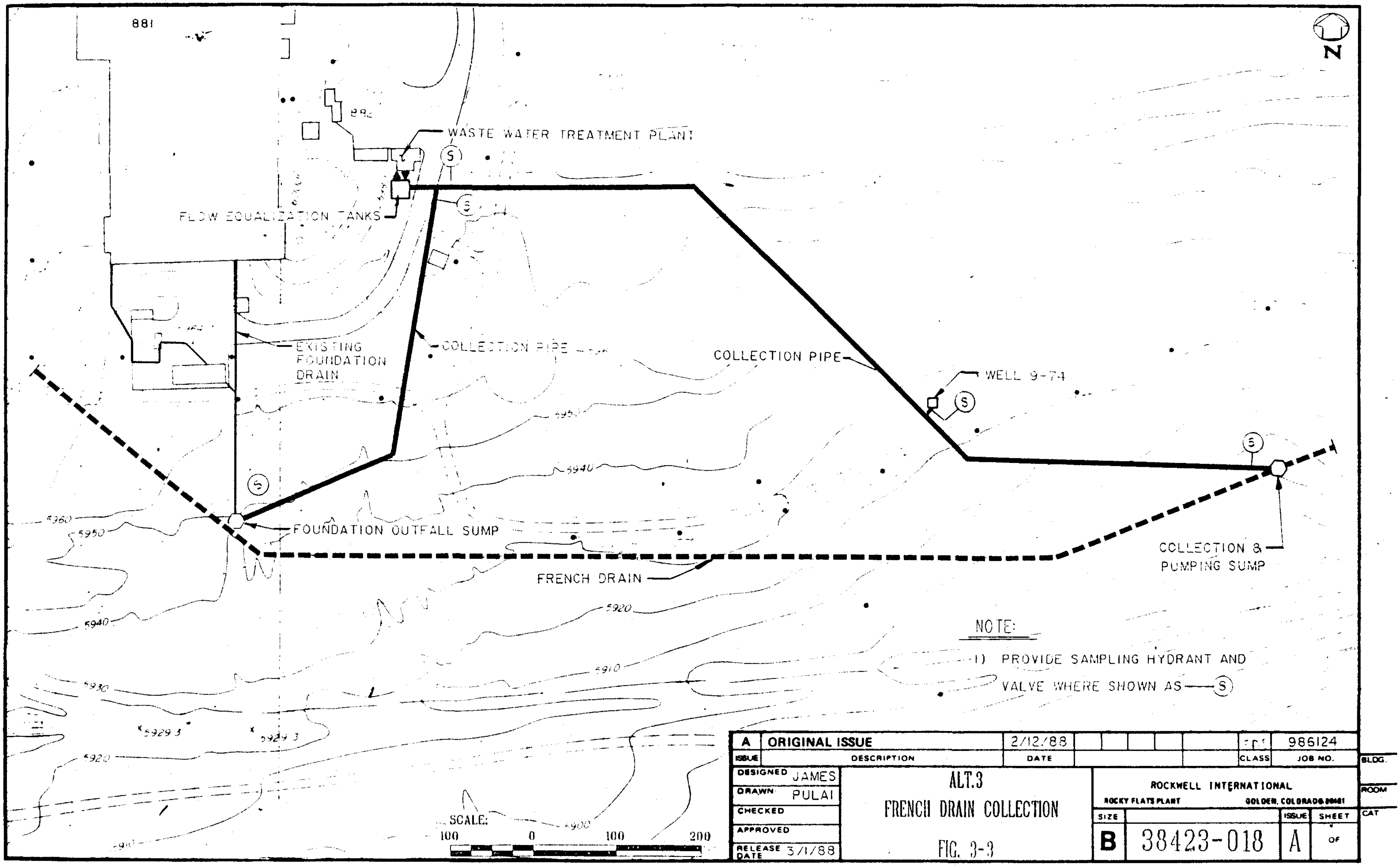
3.1 PROPOSED ACTION

Figure 3.1-1 is a conceptual drawing of the proposed action. Contaminated groundwater is to be collected from three sources, pumped to a new treatment facility, processed, and returned to the alluvium. The three collection points will be a source well identified on Figure 3.1-1 as Well 9-74, a new foundation outfall sump at the existing foundation drain, and a french drain to be constructed across the base of 881 Hillside Area. The treatment facility will consist of holding tanks, particulate filters, ion exchange resin beds to remove dissolved inorganic chemicals, and a water treatment process to oxidize the organic contaminants based on ultraviolet light and hydrogen peroxide. The treated effluent will be returned to the alluvium through a reinjection trench to be installed parallel to and hydrologically downgradient of the french drain.

A new source well will be installed near the existing sample well 9-74, which has yielded the most heavily contaminated groundwater samples taken from SWMU 119.1. The purpose of this source well is to remove a local concentration of contaminants without waiting for them to migrate to the drain, thus shortening the remediation period.

The SWMU 107 footing or foundation drain has functioned effectively for thirty years in lowering the water table near the Building 881 foundation. A precast concrete sump will be placed beneath the outfall. Submersible pumps and underground piping will be installed to carry the collected groundwater to the treatment facility. Electrical lines will be installed to provide power to the pumps.

A 1680' long trench will be constructed across the hydrologic base of 881 Hillside, from the soil surface to the bedrock (see Figure 3.1-1). An impermeable membrane on the downgradient side of the trench will insure positive cutoff of groundwater flow. A french drain consisting of porous plastic pipe embedded in drain rock will be installed prior to backfilling to

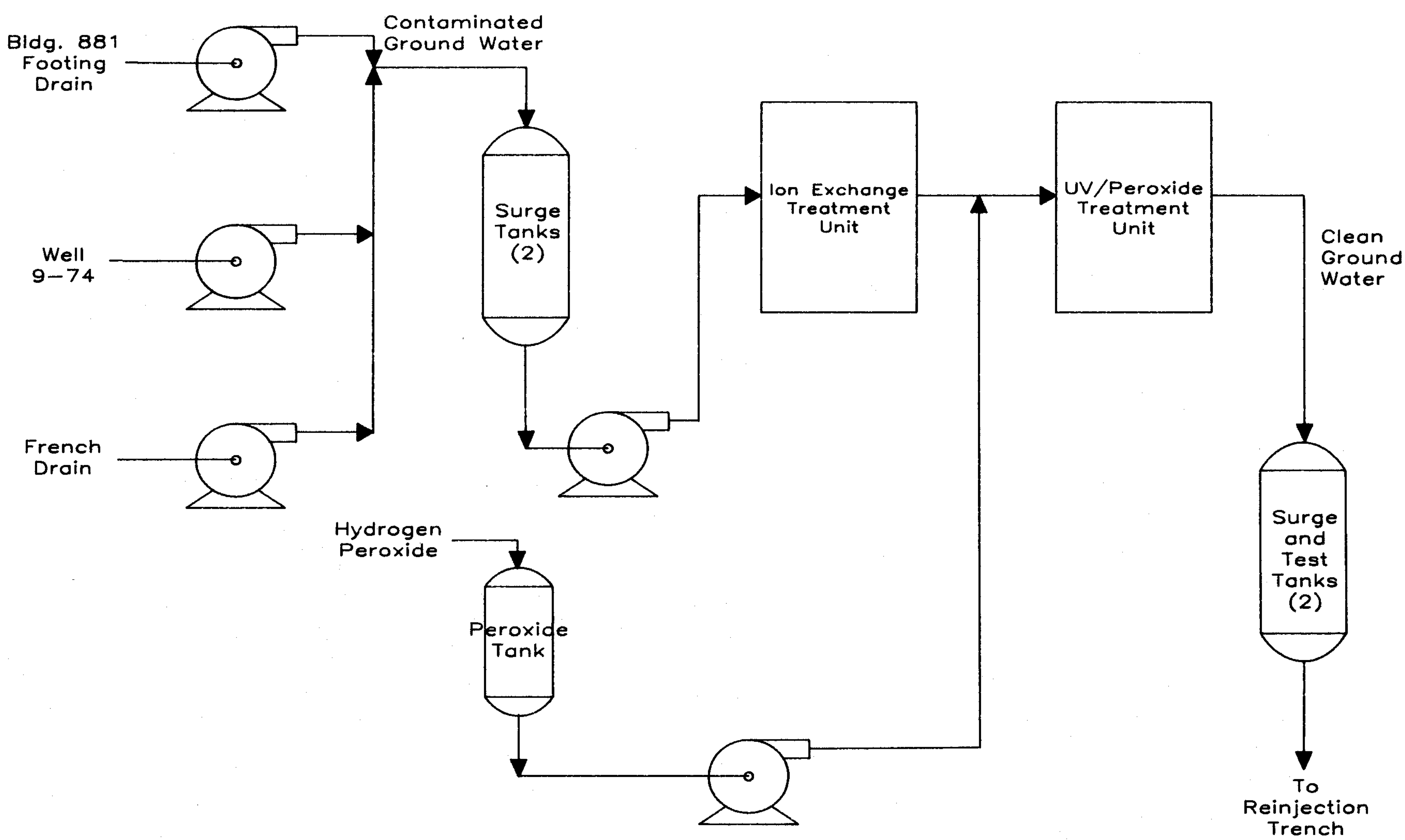


PROPOSED ACTION CONCEPTUAL DIAGRAM

FIGURE 3.1-1

collect the groundwater. A filter fabric will be placed on the upgradient side at the bottom of the trench to minimize the risk of clogging. A sump at the eastern end will collect the collected groundwater. Submersible pumps will transfer the water to the treatment facility through buried piping.

A treatment facility will be constructed inside an existing structure on the east side of Building 881. Two 15,000-gallon influent tanks and two 15,000-gallon effluent tanks will be placed on a pad adjacent to the Treatment Facility. A treatment technology using ultraviolet light and hydrogen peroxide is proposed, which effectively destroys volatile organic chemicals without prior concentration or removal. It is a simple system made up of an eighty-gallon reaction tank, ultraviolet lamps, a small hydrogen peroxide feed tank, small capacity pumps, and piping. The building will also house facilities to remove dissolved inorganic chemicals using ion exchange resins and the associated regeneration chemical tanks, pumps, and piping to permit recharging the ion exchange resins. Figure 3.1-2 is a simple flow diagram of the treatment system. The alternatives to the UV/hydrogen peroxide treatment for volatile organic chemicals -- carbon adsorption and air stripping/carbon adsorption -- have roughly equivalent cost but concentrate the contaminants into a carbon matrix for later treatment or disposal. The byproducts of using the UV/peroxide treatment technology are carbon dioxide and water, neither of which is classified as hazardous under Colorado or federal law. The treatment system may also discharge limited amounts of oxygen (also not classified as hazardous) and insignificant levels of volatile organic compounds (see Section 5.5.2). The Preferred Alternative of the FS after which the proposed action is fashioned did not address the removal of inorganic constituents because of the insufficient data base to establish these inorganic constituents as site contaminants. New background characterization studies will allow a more accurate assessment about whether the historical activities at the 881 Hillside area are responsible for the apparently elevated levels of inorganic chemicals. One advantage of the preferred alternative selected in the FS over some of the other alternatives analyzed was the ease with which treatment for inorganic chemicals could be installed, if necessary, at a later date when the final background characterization report became available. However, to avoid delaying



881 Hillside Water Treatment Facility

Figure 3.1–2

remediation until after the final background characterization report becomes available and yet remain consistent with the final remedial actions as determined when the additional background characterization data has been analyzed, it is planned to initiate interim remedial action under CERCLA upon the issuance of a Finding of No Significant Impact (FONSI). This interim action would include both treatment of organic chemicals by the UV/peroxide treatment and removal of the dissolved inorganic chemicals using ion exchange resin treatment of the collected water. The Department of Energy reserves the option to discontinue treatment for inorganic chemicals if the background characterization studies determine that the levels are within the range of natural background or if the inorganic chemical concentrations are at or below applicable water standards.

The use of ion exchange resin beds for removal of dissolved inorganic chemicals is a proven technology in extensive use at other parts of the Rocky Flats Plant and many other, diverse industrial settings. The technology involves routine regeration of the resins. The waste brine that is generated is suitable for processing in the existing evaporator at Building 374.

A reinjection trench will be placed hydrologically downgradient of the french drain for the reinjection of the treatment plant effluent back into the alluvium from which it was withdrawn. It will be sized to handle the full french drain flow. It will be parallel to the french drain and will be of somewhat greater length than the drain itself.

3.2 TECHNOLOGIES EVALUATED IN THE FEASIBILITY STUDY

For the 881 Hillside Areas, six general categories of remedial action (General Response Actions) were identified in the FS, Section 2. Specific technologies fo the General Response Actions were then identified.

The National Contingency Plan (NCP, authorized under CERCLA) provides the following guidance concerning applicability:

The alternatives developed . . . will be subject to an initial screening to narrow the list of potential remedial actions for further detailed analysis. . . . Three broad criteria shall, as appropriate, be used in the initial screening of alternatives:

(1) Cost. For each alternative, the cost of implementing the remedial action must be considered, including operation and maintenance costs. An alternative that far exceeds the costs of other alternatives evaluated and that does not provide substantially greater public health or environmental protection or technical reliability shall usually be excluded from further consideration.

(2) Acceptable Engineering Practices. Alternatives must be feasible for the location and conditions of the release, applicable to the problem, and represent a reliable means of addressing the problem.

(3) Effectiveness. Those alternatives that do not effectively contribute to the protection of public health and welfare and the environment shall not be considered further. If an alternative has significant adverse effects, and very limited environmental benefits, it shall also be excluded from further consideration.

(40 CFR 300.68(g) (1987) from 50FR47969, Nov. 20, 1985)

Accordingly, in the FS process, options not technically feasible, lacking in effectiveness, or incurring costs significantly greater than other options while yielding similar results were excluded from further consideration. A detailed description of the process used for choosing technologies, the results of that process, and the process for formulating remedial action alternatives from the remaining technologies is presented in Sections 2.0 and 3.0 of the FS. Figure 3.2-1 presents a summary of the general response actions and remedial technologies considered in the FS.

FIGURE 3.2-1

Response Actions and Remedial Technologies

General Response Actions	Associated Remedial Technologies
1. No Action	- monitoring
2. Complete or partial removal	- off-site landfill
3. Ground-water collection and containment controls	- well array - subsurface drains - subsurface barriers
4. Infiltration controls	- capping - grading - surface water diversion
5. In-site treatment/ immobilization	- immobilization - soil flushing - aeration - bioreclamation - carbon absorption
6. Groundwater treatment	- wet air oxidation - supercritical water - reverse osmosis - biological treatment - UV/peroxide or UV/ozone - aeration basin - air stripping - carbon absorption

3.3 ALTERNATIVES RETAINED FOR ENVIRONMENTAL ASSESSMENT EVALUATION

In addition to the proposed alternative, seven other alternatives were considered in the Feasibility Study Report as respresentative of the range of appropriate approaches to remediation of the 881 Hillside. The alternatives were examined as required by the NEPA regulations, which state that an agency shall "Study, develop, and describe appropriate alternatives to recommended course of action. . ." (40 CFR 1501.2(c) (1987)).

The text which follows is a short description of the construction and operational phases of the alternatives retained for the Environmental Assessment. A generalized comparison of each alternative's costs, risks, and environmental impact to those of the proposed action is presented in Section 6 of this document.

All of the remedial actions under consideration address the volatile organic constituents of the contamination with no provision for the removal or destruction of inorganic chemicals. For those alternates that involve collection of water for treatment (see 3.3.2, 3.3.3, 3.3.6, and 3.3.7 below) treatment of the water by passage through ion exchange resins could be added to the processing as described in 3.1 above.

3.3.1 No Action

Semi-annual monitoring of ground and surface water conditions would be pursued over a thirty-year period or until concentrations of volatile organic contaminants drop below detectable limits due to natural dilution or other material removal processes. This alternative does not collect, contain, or remove the contaminants identified at the site. Therefore, if contaminants were to appear in pathways that could cause offsite exposures, other alternative actions would have to be initiated at that time.

3.3.2 Comprehensive Well Array and Treatment

In place of the proposed action's french drain, a line of dewatering wells would be installed at the base of 881 Hillside to collect all groundwater flows passing through the contaminated areas. The wells would feed a collection header, whose flow would be added to flows from the SWMU 119.1 source well and the SWMU 107 footing drain collector to the new treatment facility east of Building 881.

3.3.3 French Drain and Soil Flushing

To speed the removal of contaminated liquids in the soils of SWMU 119.1, a leach field would be added to the proposed action to implement soil flushing. A portion of the treatment plant's effluent would be diverted to the leach field which would be located in the uphill section of SWMU 119.1. The treated effluent would leach into the soils, displacing the contaminated liquid downwards towards the source well and french drain. Soil flushing might result in a significant time savings in remediation over the proposed action. Such soil flushing could be added to the proposed remedial action in the future if experience with the proposed action indicated a need to accelerate the cleanup. The addition of soil flushing would, however, involve a significant amount of excavation to provide an effective leach field.

3.3.4 Total Encapsulation

A multi-layered cover (RCRA Cap) and soil-bentonite slurry walls keyed into the claystone bedrock would provide contaminant containment and groundwater diversion. Pre-existing and intrusive groundwater would be periodically removed by a new sump and submersible pumps located within the encapsulated area, transported by tank truck, and treated at an existing on-site wastewater facility.

3.3.5 Immobilization

A polymer grout, introduced through four hundred sixty injection wells, would be used to divert groundwater flow around the area containing the already contaminated groundwater and to physically immobilize the contaminants in place. No removal of groundwater or soil would be involved. A ground and surface water monitoring program would measure the system's performance.

3.3.6 Source Well and Footing Drain Collection with Treatment

As in the proposed action, contaminated groundwater would be collected from a source well at SWMU 119.1 and a new sump at the existing SWMU 107 footing drain outfall and piped to a new treatment facility in an existing structure east of Building 881. Unlike the proposed action, only these two removal points would be used, with treated effluent returned to the alluvium at the base of 881 Hillside.

3.3.7 French Drain and Partial Excavation

The proposed action's remediation period would be reduced through the excavation of 3,000 cubic yards of soil from a circular area centered on the SWMU 119.1 source well.

4.0 POTENTIALLY AFFECTED ENVIRONMENT

4.1 DESCRIPTION

Rocky Flats Plant is located in rural Jefferson County, five miles from the nearest school and ten miles from the nearest hospital. The Plant's immediate neighbors are agricultural and industrial operations with few residents. On the western (upstream) side of the Plant exist several low-density residential areas, all several miles distant. To the southeast, growth in the northwest Denver suburbs has pushed development in the Plant's direction. Residential subdivisions exist within two miles of the buffer zone boundary. The buffer zone insures that, other than at the plant and selected industrial sites, no development can occur within 1.6 miles of the contaminated source areas. In the twenty years 1980-2000, the number of residents within five miles of the Plant is expected to more than double, from 9,500 to 20,000 (Rockwell International, 1988a).

The name Rocky Flats refers to the five-mile wide terrace of cobbly alluvium on which the Plant sits. The terrace surface, at about six thousand feet in elevation, was built up from the sedimentary bedrock by deposits from the weathering of the adjacent mountains. The result is a wide rock-covered flat which slopes east from the base of the foothills of the Front Range, the nearest of which falls to the plain two miles west of the Plant. Technically, the area is the western edge of the Denver Basin in the Great Plains Tectonic Province. The foothills bordering to the west are the Front Range Uplift of the Southern Rocky Mountains. The basin itself is characterized by sedimentary rock capped with alluvial deposits from the adjacent mountains.

There are four main drainages from the Plant property: North Walnut, South Walnut, Rock and Woman Creeks. All are intermittant and ephemeral streams which provide and drinking water and irrigation water. There are a number of ditches crossing the area as well, conveying water collected off-site to other areas, the Plant, Walnut Creek, or Woman Creek. Until late 1974, Plant waste water had been discharged to Walnut Creek, and until 1975, filter backwash from the raw water treatment plant went into Woman Creek. All process waste water is now disposed of through evaporation and recycle on-site. Sanitary waste water is discharged in accordance with the NPDES permit effluent limitations when onsite spray irrigation is not feasible.

Rocky Flats is situated in a semi-arid region, averaging fifteen inches of annual precipitation. Forty percent of the yearly total comes in the spring, much of it in the form of snow. Of the balance, thirty percent is accounted for by summer thunderstorms, with the rest falling in the fall (11%) and winter (19%) months. Average yearly snowfall averages eighty-five inches. Runoff control structures exist to channel surface water from the Plant to monitoring ponds. These structures are sized to accommodate the one-hundred-year storm event depositing four inches of water in a six-hour period.

Mineral resources occurring in the vicinity of the Plant include sand, gravel, crushed rock, clay, coal, and uranium. With the exception of coal, all are actively mined. The remaining coal, last mined locally in 1950, does not exist in an economically recoverable form. Active sand and gravel mines lie within the buffer zone boundaries. There is a currently inactive aggregate processing facility adjacent to the northwest corner of the buffer zone which is scheduled to be re-opened in 1989.

The Rocky Flats area is no longer volcanically active, the last eruption in this area having occurred four thousand years ago at Dotsero, one hundred miles to the west. The area is classified as Seismic Zone 1, indicating a minor potential for earthquake damage. The nearest known "capable" fault is more than ten miles away in the vicinity of the Rocky Mountain Arsenal, north of Denver. Associated with the deep well injection of liquid wastes at the Arsenal is the Derby Earthquake Series, which began in 1962, apparently came to an end in 1967 with the cessation of injection, and resulted in tremors with magnitudes as great as 5.3 on the Richter scale. Newspapers in 1882 carried an account of what is thought to have been the worst earthquake in recent history (6.5 Richter) and has been tentatively located about 13 miles from the site. Faults identified in the area closer than the Rocky Mountain Arsenal have not shown signs of recent activity and are not thought to be "capable" (DOE, 1980).

Groundwater is present in surficial materials at the 881 Hillside under unconfined conditions. Recharge to the water table ocurrs as infiltration of incident precipitation and as seepage from ditches and creeks. The shallow groundwater flow system is quite dynamic, with large water level changes occurring in response to precipitation events and to stream and ditch flow. Groundwater flows from the Rocky Flats Alluvium at the top of the 881 Hillside south through colluvial materials toward Woman Creek. Flow through colluvial materials appears to primarily occur in the gravel within the colluvium. At the Rocky Flats terrace edges, groundwater emerges as seeps and springs at the contact between the alluvium and claystone bedrock (contact seeps), is consumed by evapotranspiration, or flows through colluvial materials following topography toward the valley fill and terrace alluviums. Once groundwater reaches the valley, it either flows down-valley in the alluvium, is consumed by evapotranspiration, or discharges to Woman Creek.

Human impacts through burning, timber cutting, road building, and overgrazing have altered the Rocky Flats area's landscape. Since the acquisition of the Rocky Flats Plant property, vegetative recovery has occurred as evidenced by the presence of grasses like big bluestem and side-oats grama (two disturbance-sensitive species). On the 881 Hillside, the relatively stable soil supports heavy vegetation growth of primarily introduced grasses. No vegetative stresses attributable to hazardous waste contamination have been identified (DOE, 1980).

The animal life inhabiting the Rocky Flats Plant and its buffer zone consists of species associated with western prairie regions. The most common large mammal is the mule deer, with an estimated 100-125 permanent residents. There are a number of small carnivores, such as the coyote, red fox, striped skunk, and long-tailed weasel. A profusion of small herbivore species can be found throughout the plant and buffer zone consisting of species such as the pocket gopher, white-tailed jackrabbit, and the meadow vole (Rockwell, 1988c).

Some 38 species of bird have been identified on the site, ranging from the blue heron to the mallard duck. Among the birds of prey, the American

Rough-Legged Hawk, the Marsh Hawk, and the Ferruginous Hawk have been sighted on the site.

Seven known species of reptile have been identified on the site, including the Western Leopard frog, the Painted Box turtle, and the Prairie rattlesnake. In the wetter parts of the site, Largemouth bass, Rainbow trout, and four families of crustaceans. Insects belonging to six family groups can be found at the site (Rockwell International, 1988c, Vol. X, Appendix H).

4.2 REGULATORY COMPLIANCE

Facilities of the U.S. Department of Energy (DOE) are required to operate under a policy of full compliance with applicable environmental regulations while conducting their missions. The DOE Albuquerque Operations Office (AL) Environmental Restoration Program is chartered to help fulfill that commitment at installations within the AL complex. The proposed actions are part of this Environmental Restoration Program.

The Program covers the major environmental regulations, such as the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), National Environmental Policy Act (NEPA), Clean Air Act (CAA), Clean Water Act (CWA), Safe Drinking Water Act (SDWA), Toxic Substances Control Act (TSCA), and Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), with emphasis on CERCLA and RCRA.

Authority to implement the Environmental Restoration Program is primarily derived from the following DOE and AL orders:

-- Comprehensive Environmental Response, Compensation, and Liability Act Program (DOE 5480.14);

-- Hazardous, Toxic, and Radioactive Mixed Waste Management (DOE 5480.2 and AL 5480.2);

-- Prevention, Control, and Abatement of Environmental Pollution (Ch. XII of DOE 5480.1 and AL 5480.1);

-- Environmental Protection, Safety, and Health Protection Information Reporting Requirements (DOE 5484.1 and AL 5484.1);

-- Implementation of the National Environmental Policy Act (DOE 5440.1C and AL 5440.1B).

4.2.1 Wetlands

Cleanup activities will not occur within the boundaries of identified wetlands. No dredging or filling will occur and the remedial activities will not alter the hydrologic characteristics of nearby Woman Creek. This action will not impact wetlands.

4.2.2 Endangered Species

The U.S. Fish and Wildlife Service has indicated that the two endangered species of interest in the RFP area are the bald eagle and the black-footed ferret (USFWS 1988). There are no prairie dog towns in or near the 881 Hillside remedial investigation area. Without the food source and habitat provided by the prairie dogs, the USFWS has determined that ferrets probably do not exist in the investigation area. Bald eagles are occasional visitors to the area, primarily during migration times. Sightings are rare and little suitable habitat occurs on plant site other than some perching locations. No nests occur on plant site. This project will not adversely affect the bald eagle. The USFWS has concurred with these findings subsequent to a field visit by Mr. Mike Lockhart of the FWS dated 6/15/88.

4.2.3 Raptors

Other species of high Federal interest that exist in the RFP area include burrowing owls and Swainsons hawks. Cottonwood trees within 1/4 mile of the 881 Hillside area were investigated to determine if any raptor nests existed in the trees. None were found and the trees will be reinspected in the spring to ensure that activities do not disturb nesting or broods of young. The nearest burrowing owls are approximately 2 miles to the east.

4.2.4 Archaeology

The 881 Hillside area has been highly disturbed over a number of years. Due to this disturbance and the topographic position of the program area, the State Office of Archeology and Historic Preservation has determined that this action will not impact cultural resources (DOE, 1988).

5.0 ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

5.1 AIR QUALITY

There are three potential air quality impacts associated with the proposed action:

1. Volatile organic solvents released from exposed contaminated liquids. The liquids could be exposed during activities such as well-drilling, excavation, and spills of collected liquids.

2. Water treatment process offgases released to the environment as part of normal operations or accidental conditions.

3. Fossil fuel consumption-related exhausts and suspended soil dusts resulting from activities such as excavation, construction, maintenance, and monitoring.

Air quality impacts from construction activities associated with the treatment facility, french drain, well, footing drain, and associated utilities are small when compared to the normal operational activity at Rocky Flats Plant. Dust associated with these activities will be controlled as specified in the Job Safety Analysis.

The releases of volatile organics from exposed liquids is addressed later in this section under Personnel Exposures and will not be discussed here.

The offgases from the ultraviolet light/hydrogen peroxide treatment system consist of oxygen, carbon dioxide, water vapor and trace amounts of volatilized organics. The amounts of oxygen, carbon dioxide and water vapor released will not cause measurable changes in the levels of these gases in the ambient air. The trace amounts of volatilized organics released from tank vents or through routine system leakage during normal operation are well below regulatory limits (as described in Section 5.5). Accidental conditions are examined later under Personnel Exposures.

The ion exchange resin treatment would not provide any significant contribution to offgases either during normal operation or during resin recharge operations. Minor leaks of liquid used for resin recharge and resins exposed to the air during resin bed charging may contribute to odors within the confines of the water treatment building and will be controlled by adequate ventilation. These will not be noticeable from outside the building nor are they a hazard to workers in the building under normal circumstances. Spills of resin recharge chemicals that might be involved in accident conditions would be controlled by actions specified in the Operational Safety Analysis.

5.2 WATER QUALITY

Impacts to water quality arising from the proposed action could come from surface runoff entering and flooding drain and utility excavations, soil entrainment (sediment transport) by surface runoff ending in open waters, and potential spills of collected contaminated water into surface waters.

Many surface and groundwater quality impacts could result from the release of contamination at 881 Hillside if no remedial action is taken. Implementation of the proposed action would clean up these contaminants preventing the possibility of future offsite releases.

The VOCs in SWMU 119.1 have all been reported in ground water samples, not in the soil samples. The excavations performed above the water table (such as the shallow trench for the water collection or return piping) will not involve soils contaminated with VOCs. The soil where the trenches for the french drain and reinjection lines will be dewatered before excavation. Ordinary dust and erosion control measures will be adequate to protect any surface water runoff from contamination by VOCs.

While VOCs are not present in the soils, much of the excavation for the trenches will be through soils that are expected to have measurable levels of low volatility organic chemicals, primarily bis(2-ethylhexyl)phthalate (DEHP). Because DEHP is not transferred from the soil to water in measurable quantities, surface water runoff should not cause a water quality concern as long as erosion control measures are applied to all soils excavated during the remedial action.

Prior to work in any area, surveys will be performed to detect the presence of localized radioactive contamination. If located, this localized radioactive contamination will be removed as described in Section 5.5.1 of this report.

Piping, dewatering wells and accumulations of contaminated water will be hydrologically upstream of the french drain excavation. All spills would be intercepted by the dewatering wells or the drain trench.

The greatest potential for impacts on the water quality from the ion exchange resin process is in conjunction with chemicals involved with the periodic recharge of the resins. Handling of the concentrated recharge chemicals will be governed by the Operational Safety Analysis as will the precautions for handling the waste brines and transportation of the waste brines to the treatment facility. Procedures will be established to assure that waste brines from resin regeneration are segregated from the treated groundwater to prevent contamination of the groundwater by such waste brines.

Liquid wastes generated during resin recharge operations will be transported to an evaporator in another facility on the RFP site (Building 374). These wastes are similar to other liquid wastes generated at RFP that are treated at the existing evaporator and involve no unique hazards or concerns for workers. The volume of recharge liquids involved will not be a significant addition to those already processed by the 374 Building evaporator treatment facility. Thus the collection, transport, and treatment of recharge liquid wastes will be in accordance to standard plant operating procedures and do not present a significant hazard to offsite water quality.

5.3 TERRESTRIAL IMPACTS

The three features of the terrestrial environment to be impacted will be animal life, plant life, and land contour.

Excavation for the french drain, reinjection trench, and piping trenches will be locally destructive to the covering vegetation and ground-dwelling rodents and insects. The area involved will be less than 5% of the surface area of the 881 Hillside Area. As none of the rodents, insects, or vegetation is endangered, in short supply, or exhibiting signs of contaminant stress, they will quickly re-establish their populations in the disturbed areas.

Contour changes will be small and likely indiscernible where they occur.

5.4 SHORT- AND LONG-TERM LAND PRODUCTIVITY

This area is currently undeveloped and will remain so for the foreseeable future as a part of the Rocky Flats Plant. The 881 Hillside is within the security boundaries and is not accessible to the general public.

5.5 PERSONNEL EXPOSURES - ROUTINE OPERATIONS

5.5.1 Installation/Construction

The construction of the water treatment facility should not expose workers to any significant hazards beyond ordinary construction. The soil samples from the areas closest to the location of the french drain and reinjection trench yield no significant amounts of volatile organic chemicals (VOCs). Well water samples from the area hydrologically upstream of the location of the french drain do show low levels of VOCs. With the exception of one sample which yielded 6 $\mu g/l$ of 1,1-Dichloroethene, no wells located hydrologically downstream of the french drain have yielded measurable quantities of VOCs in the alluvial groundwater.

It is not expected that exposure to VOCs would occur in the area around the trenches or at the stockpile of excavated soil because they are in unconfined areas. During construction activities, monitoring for VOCs will be conducted and any necessary protective action, such as the use of respiratory protective equipment, will be taken as prescribed by Health, Safety and Environment personnel and the Job Safety Analysis specific for this installation.

The extent to which workers may be exposed to VOCs during french drain or reinjection trench construction cannot be accurately assessed at this time for the following reasons:

a) Vapor concentration estimates in the open trenches are difficult to establish because all vapor releases will be in unconfined spaces so that buildup is unlikely to occur.

b) Dewatering, which will be performed prior to installation of the drain and reinjection trench, will leave an indeterminant amount of liquids in the soil.

c) Unknown rate and depth of volatilization of the VOCs and the time between trench excavation and any entry into the trench prevent meaningful estimation of either vapor exposures or dermal exposures to such VOCs.

While soil samples from borings taken in the area where the drain and trench will be installed did not contain volatile organic chemicals, some borings did yield measurable levels of low-volatility organic chemicals which could lead to dermal exposures to workers during drain installation. Estimations of dermal exposure to low volatility organic chemicals and attendant carcinogenic and noncarcinogenic risk estimates have been performed. The results of these estimates, along with the data and assumptions made are shown in Appendix D, Risks From Exposures During Installation. As may be seen from these calculations, risks to workers from dermal contact with low-volatility organic chemicals, either chronic or acute, are not significant. Uranium, the only radioactive material detected above minimum detectable limits in soil borings and water samples taken in the work area for the drain installation, and the other inorganic metals identified in the Risk Assessment are not readily absorbed through the skin, thus they do not present a risk to workers from dermal exposure.

Radiation surveys have indicated there are small isolated areas of localized surface contamination. Analyses of surface samples have yielded no plutonium results greater than 5 pCi/gm. EPA interim recommendations do not require actions to be taken when soil contamination is effectively less than 20 pCi/gm. (U.S. Environmental Protection Agency, Office of Radiation Programs, Interim Recommendations on Doses to Persons Exposed to Transuranium Elements in the General Environment (draft)). Elevated levels of uranium have been identified in surface soils, however, with measured levels as high as 3,072 pCi/gm. This uranium is insoluble and has remained at or near the soil surface without migrating to the groundwater. Any localized radioactive contamination will be excavated and the soil packaged as low-level waste and shipped to an appropriate disposal site.

The only pathway of concern for either workers or the general public* would be inhalation of fugitive dusts generated during the excavation. Dust control measures would be employed to limit such exposures. Nonetheless, estimates have been made to establish a level of soil contamination that could lead to respiratory control measures for workers as well as exposure levels for members of the general public at the nearest off-site location. As shown in Appendix D, soil contamination would have to reach an average level of 1×10^4 pCi uranium/gram of soil before uranium exposure would be of concern at airborne dust loading of 10 mg/m^3 (the OSHA limit for nuisance dusts). As is also shown in Appendix D, even if enough uranium-contaminated dust were to be stirred up to maintain an average dust loading of 10 mg/m^3 over an area four meters high and ten meters long, offsite uranium concentrations would still be about a factor of 10 less than the maximum permissible concentration of uranium (234, 235, or 238 in any mixture) in air for release to uncontrolled areas, assuming no dust settling over the 1.9 km distance to the closest offsite location.

No impact from chemical toxicity of the uranium in fugitive dusts is expected because no soluble forms of the uranium would remain at the soil surface.

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* Throughout this report, the term "general public" has a special and very restricted meaning. In order to estimate the maximum exposure or risk to persons outside of the RFP site, all estimates are based on exposure to a person staying at the site boundary (or wherever the air concentration would be the greatest) for 24 hours each day, 365 days each year, for the duration of the operation or the remedial action (see also Appendix B).

A new source well will be drilled about 15 feet from the existing well number 9-74. Prior to drilling of the well, the area into which the well will be drilled will be dewatered using well 9-74. The damp soils removed during the drilling (estimated to be three cubic yards) will be spread on the surface of the surrounding soil.

Because most of the contaminated water will have been removed during the dewatering before the well-drilling begins and the soil will be exposed in an unconfined area, VOC exposure from the air will be small. The analysis of risks from dermal exposure to soil-borne Bis(2-ethylhexyl)phthate in the soil described in Appendix D used the maximum recorded concentration of the chemical in the analysis of non-carcinogenic risk. Because the non-carcinogenic risks are based entirely on the maximum exposure level, the non-carcinogenic risks to workers during drilling operations will not be greater than those calculated in Appendix D. Carcinogenic risks are based both on exposure level and period of exposure. Although the exposure levels in well drilling may be the maximum concentration observed (which is 2.6 times higher than the average concentration used in Appendix D for the carcinogenic risk analysis), the total carcinogenic risks from the well drilling will be less than those analyzed in Appendix D because the period of exposure will be much shorter (twenty times less than the exposure period for french drain installation assuming three days to drill the well). Monitoring will be conducted during the well drilling as required by the Job Safety Analysis, and Health, Safety, and Environmental representatives will prescribe further worker protection actions.

Exposure to workers installing the piping to the treatment plant from collection points is not a health hazard because the piping is to be buried above the level of the water table, because soil sample analysis did not indicate volatile organic chemicals, and because the levels of low-volatility organic chemicals do not exceed those used in the analysis for the french drain trench excavation which yielded insignificant risk estimates.

During construction/installation of the proposed action, exposures to the general public would be limited to the possibility of exposure to airborne volatile organic chemical vapors released during the excavation for the french drain and reinjection trench installation or from off-gassing of water withdrawn during dewatering operations associated with the drain installation. Dust control procedures will eliminate any risks to the general public from low-volatility organic chemicals, inorganics, or uranium (the only radionuclide identified) through exposure to fugitive dusts. Because the liquids from dewatering do not include the source well, the concentration levels in the dewatering fluids will be less than those used for analysis of either routine operation or accident conditions and need not be analyzed further.

As noted in the Feasibility Study, it is estimated that, following the initial pump-down, the liquid yield from the french drain would be about two gallons per minute. As a conservative estimate of the source term for VOC vapor released from the trench during construction, it is assumed that even with dewatering operations, there will be a vapor release equivalent to complete off-gassing of vapors from two gallons of water per minute. The concentration of VOCs in the water is assumed to be equal to the average of the well water samples taken in the areas closest to and hydrologically upstream of the trench location. The methods used to estimate the risks to non-workers associated with this release path are described in Appendix A. The risk estimates are summarized in Table 5.5.1-1.

5.5.2 Routine Operation

During routine operation of the water treatment facility, operating personnel may be exposed to low concentrations of VOCs. It is expected that such exposure will not exceed two hours per day for five-day weeks. The waste treatment process is a closed system, so large volumes of untreated water are not available to produce VOC vapors within the building. The UV/peroxide treatment does not concentrate the hazardous materials. Exposures, therefore, cannot involve sources of greater concentration than the collected liquids. The only normal exposure to either vapors or contact would be due to minute leaks in system plumbing prior to treatment, or during sampling or maintenance. Vapor exposures will be controlled with adequate ventilation of the water treatment building. Contact exposures will be controlled as specified in the Operational Safety Analysis (OSA) for operating the facility.

Table 5.5.1-1

RISKS TO THE GENERAL PUBLIC[3] FROM FRENCH DRAIN INSTALLATION

Volatile Organic Chemical	VOC Concentration (mg/l)	Source Term (mg/sec)	Air Concentration (mg/m^3)	Adult Risk[1] Carcinogenic	Adult Risk[1] Non-Carc.	Child Risk[1] Carcinogenic	Child Risk[1] Non-Carc.
Carbon Tetrachloride	3.57 E-3[2]	4.50 E-4	6.76 E-8	8.25 E-12	< 0.01%	9.63 E-12	< 0.01%
1,2-Dichloroethane	4.93 E-3	6.22 E-4	9.33 E-8	3.07 E-12	< 0.01%	3.58 E-12	< 0.01%
1,1-Dichloroethene	2.50 E-3	3.15 E-4	4.73 E-8	5.16 E-11	< 0.01%	6.01 E-11	< 0.01%
t-1,2-Dichloroethene	0	0	0	--	< 0.01%	--	< 0.01%
Tetrachloroethene	9.63 E-3	1.22 E-3	1.82 E-7	2.91 E-13	< 0.01%	3.40 E-13	< 0.01%
Trichloroethene	5.45 E-2	6.88 E-3	1.03 E-6	4.46 E-12	< 0.01%	5.20 E-12	< 0.01%
TOTAL	7.51 E-2			6.76 E-11		7.89 E-11	

Exposure duration = 60 days

Liquid Flow Rate = 2 gpm

Exposure time adjustment = 1

1 See Appendix B, Specific Risk Estimation Terms.

2 3.57 E-3 = 3.57×10^{-3} = 0.00357

3 In order to estimate the maximum exposure or risk to the general public, all estimates are based on the exposure to a person staying at the RFP site boundary (or wherever the air concentrations would be the greatest) 24 hours perday, 365 days per year.

The inorganic chemicals, including uranium, are not volatile and are not readily absorbed through the skin. Only oral intake presents any significant potential concern. Possible accumulations from minor leaks or spills will be controlled to low levels by ordinary good housekeeping practices and as specified in the Operational Safety Analysis. Ion exchange resins could contain higher concentrations of inorganic chemicals, but these would not be readily available for transfer off the resins (until they are subjected to the recharge chemicals). As described previously, handling recharge chemicals as well as the waste brines associated with resin recharge will be similar to other operations currently performed at the plant and will be governed by the Operational Safety Analysis.

Water returned to the alluvium will meet the applicable water standards for each of the inorganic chemicals of concern unless it is demonstrated by the background characterization studies that the levels of inorganic chemicals are within the range of natural background for the area and hence are not being increased by activities at the 881 Hillside Area.

Four pathways have been identified for VOCs that might impact non-workers. Trace amounts of VOC's may be present in the treatment building ventilation exhaust. In routine operations, this might include VOCs from minute leaks in the plumbing or VOCs released during sampling or maintenance of the system. Such releases are much less than the offgassing from treated effluent (see next paragraph).

Small amounts of VOCs may remain in the treated effluent. Although this effluent is to be returned to the alluvium, some vapors may escape through the effluent surge tank vent. In order to make an upper-bound estimate of the risks associated with this pathway, it was conservatively assumed that 100% of the VOCs remaining in the treated effluent are released to the air. The risks asociated with this exposure route were calculated using the techniques described in Appendix A and are summarized in Table 5.5.2-1.

The influent collection tanks are to be vented to the atmosphere which may lead to the release of VOC vapors prior to water processing. The methods used to estimate the risks are described in Appendix A and the calculation of

Table 5.5.2-1

RISKS TO THE GENERAL PUBLIC[4] FROM PROCESSED WATER OFFGAS

Volatile Organic Chemical	VOC Concentration[1] (mg/l)	Source Term (mg/sec)	Air Concentration (mg/m^3)	Adult Risk[2] Carcinogenic	Adult Risk[2] Non-Carc.	Child Risk[2] Carcinogenic	Child Risk[2] Non-Carc.
Carbon Tetrachloride	5.00 E-3[3]	9.46 E-3	1.42 E-6	5.38 E-9	0.06%	5.53 E-9	0.07%
1,2-Dichloroethane	5.00 E-3	9.46 E-3	1.42 E-6	1.45 E-9	0.01%	1.49 E-9	0.01%
1,1-Dichloroethene	5.00 E-3	9.46 E-3	1.42 E-6	4.80 E-8	< 0.01%	4.93 E-8	0.01%
t-1,2-Dichloroethene	5.00 E-3	9.46 E-3	1.42 E-6	--	< 0.01%	--	< 0.01%
Tetrachloroethene	5.00 E-3	9.46 E-3	1.42 E-6	3.98 E-10	< 0.01%	4.09 E-10	< 0.01%
Trichloroethene	5.00 E-3	9.46 E-3	1.42 E-6	2.26 E-9	0.01%	2.32 E-9	0.01%
TOTALS				5.75 E-8		5.91 E-8	

Exposure duration = 30 years

Liquid Flow Rate = 30 gpm

Operating Time Adjustment = $\frac{8\text{hrs}}{24\text{ hrs}} \times \frac{5\text{ days}}{7\text{ days}} = 0.2381$

1 Operational release limits on the processed water.

2 See Appendix B, Specific Risk Estimation Terms.

3 5.00 E-3 = 5.00×10^{-3} = 0.005

4 In order to estimate the maximum exposure or risk to the general public, all estimates are based on the exposure to a person staying at the RFP site boundary (or wherever the air concentrations would be the greatest) 24 hours perday, 365 days per year.

Table 5.5.2-2

RISKS TO THE GENERAL PUBLIC[3] FROM INFLUENT TANK VENTING

Volatile Organic Chemical	VOC Vapor Conc. (mg/l)	Source Term (mg/sec)	Air Concentration (mg/m^3)	Adult Risk[1]		Child Risk[1]	
				Carcinogenic	Non-Carc.	Carcinogenic	Non-Carc.
Carbon Tetrachloride	9.00 E-5[2]	4.54 E-5	6.81 E-9	1.08 E-10	< 0.01%	1.11 E-11	< 0.01%
1,2-Dichloroethane	4.03 E-5	2.03 E-5	3.05 E-9	1.31 E-11	< 0.01%	1.34 E-11	< 0.01%
1,1-Dichloroethene	1.65 E-3	8.32 E-4	1.25 E-7	1.77 E-8	< 0.01%	1.82 E-8	< 0.01%
t-1,2-Dichloroethene	4.36 E-5	2.20 E-5	3.30 E-9	--	< 0.01%	--	< 0.01%
Tetrachloroethene	1.38 E-5	6.97 E-6	1.04 E-9	2.17 E-13	< 0.01%	2.24 E-13	< 0.01%
Trichloroethene	2.42 E-4	1.22 E-4	1.83 E-8	1.03 E-11	< 0.01%	1.06 E-11	< 0.01%
TOTALS				1.79 E-8		1.84 E-8	

Exposure duration = 30 years

Vent discharge rate = 8 gpm

Exposure time adjustment = 1

1 See Appendix B, Specific Risk Estimation Terms.

2 9.00 E-5 = 9.00×10^{-5} = 0.00009

3 In order to estimate the maximum exposure or risk to the general public, all estimates are based on the exposure to a person staying at the RFP site boundary (or wherever the air concentrations would be the greatest) 24 hours perday, 365 days per year.

the source concentration used is described in Appendix C. The risk estimates are summarized in Table 5.5.2-2.

The fourth pathway involves volatile organic chemicals that remain in the water returned to the alluvium. In order to estimate risks from this possible exposure pathway, it was assumed that the water is returned to the alluvium at the operational release limits on the processed water and that no volatilization occurs in the effluent surge tank. It is further assumed that there is no dilution or other physical or chemical mechanism operate to reduce the VOC concentrations before exposure occurs as described in the Risk Assessment for the Scenario B. It is assumed that the exposure occurs for the full estimated lifetime of the remedial action, i.e., for thirty years. Estimates were made of the risks, both lifetime carcinogenic and non-carcinogenic for adults and children by applying the ratio of the assumed processed water release concentration to the Scenario B concentrations to the risk factors for both adults and children. The adult carcinogenic risk was also reduced to account for the reduced time of exposure from sixty-five years to thirty years of exposure as an adult. The child carcinogenic risk includes five years as a child and twenty-five years as an adult. The non-carcinogenic risks are corrected only for differences in exposure concentration. The results of these calculations are summarized in Table 5.5.2-3. These risk estimates are very conservative since they assume no volatilization following processing and no dilutions from surface water recharge to groundwater.

The proposed action treats the water, not the soil in the SWMUs. For this reason, when the liquid contamination levels have decreased adequately to permit termination of the treatment, the soil may still contain some hazardous chemicals primarily low-volatility organics. However, as demonstrated in the Risk Assessment, none of the soil pathways leads to a significant risk, either to carcinogenic or non-carcinogenic health effects. The total lifetime carcinogenic risk for all soil-bound pathways is 4.37 E-7 for the maximally exposed individual in the worst-case scenario. None of the Health Effect Criteria are exceeded for any of the soil pathways in the worst-case scenario thus keeping noncarcinogenic risks below acceptable limits.

Table 5.5.2-3

RISKS TO THE GENERAL PUBLIC[5] FROM PROCESSED WATER RETURNED TO THE WATER TABLE

Volatile Organic Chemical	VOC Concentration[1] (mg/l)	Risk Assessment Scenario B Concentrations[2] (mg/l)	Concentration		Adult Risk[3]	
			Carcinogenic	Non-Carc.	Carcinogenic	Non-Carc.
Carbon Tetrachloride	5.00 E-3[4]	2.18 E-2	1.60 E-5	40%	1.95 E-5	95%
1,2-Dichloroethene	5.00 E-3	1.33 E-2	1.11 E-5	4%	1.36 E-5	9%
1,1-Dichloroethene	5.00 E-3	9.95 E-2	7.10 E-5	3%	8.68 E-5	7%
t-1,2-Dichloroethene	5.00 E-3	3.29 E-2	NA	3%	NA	7%
Tetrachloroethene	5.00 E-3	2.87 E-2	6.24 E-6	1%	7.62 E-6	3%
Trichloroethene	5.00 E-3	1.09 E-1	1.35 E-6	4%	1.65 E-6	9%
Total			1.06 E-4		1.29 E-4	

1 Operational release limits on processed water

2 Rockwell International, 1988b, Table 4-2

3 See Appendix B, Specific Risk Estimate Terms

4 5.00 E-3 = 5.00×10^{-3} = 0.005

5 In order to estimate the maximum exposure or risk to the general public, all estimates are based on the exposure to a person staying at the RFP site boundary (or wherever the air concentrations would be the greatest) 24 hours perday, 365 days per year.

NA Not Applicable

5.6 ACCIDENTAL EXPOSURES

Any accidents which might occur during the construction phase of the proposed action are those typical of small excavation or construction activities. While such an accident might lead to personnel contamination from contaminated groundwater or soils, none of the hazardous materials have been identified in concentrations immediately injurious to health. The Job Safety Analysis (JSA) will identify preventive/corrective actions and the parties responsible for each basic job. Workers will be familiar with the JSA and a copy of it will be available at the work site. It is not expected that such accidents would have an impact on non-occupational workers. No credible accident would increase VOC vapor concentration leading to exposure of either workers or non-workers.

During the routine operation, accidents that would impact either occupational or non-occupational individuals would include fires or major spills of contaminated material. Because all of the hazardous material is treated in water without increasing contamination concentration, fires would be an industrial hazard but would not produce special hazards to workers or produce airborne releases that would be significant for the non-occupational population.

Spills of untreated water within the treatment building would create the potential for short duration increased airborne releases of VOCs. Uptake of contaminants by workers involved in the cleanup would be controlled by following the Operational Safety Analysis. Exposure of workers to inorganic materials and uranium will be controlled by contamination control measures in the Operational Safety Analysis and as prescribed by Health, Safety, and Environmental personnel.

The most severe credible accident with potential for the exposure of non-workers would be the rupture of one of the 15,000-gallon influent tanks, releasing its contents to the pad on which it is located, with the subsequent off-gassing of the liquid contents. Spread of the water would be confined to the pad by the dike surrounding the pad. Other accidents, such as a pipe rupture, would release the tank contents more slowly, decreasing the acute risks, and leaving the carcinogenic risks unchanged. Appendix A describes the techniques used to estimate the risks associated with this type of accident while Appendix C describes the estimation of the liquid source term used. The rate of off-gassing from the spilled liquid is very difficult to determine. Since carcinogenic risks are based on the total uptake, the rate of release is not significant. The Health Effect Criteria are specified for daily uptakes. If it is assumed that all the dissolved VOCs are released to the air over the first twenty-four hours and that the non-worker uptake extends over the same period, any release rate may be used without changing the risk estimation. It is assumed that the liquid is released at 10.417 gpm (15,000 gallons in 24 hours) in the risk calculations. Table 5.6-1 summarizes the estimated risks calculated using the techniques described in Appendix A.

5.7 COMMITMENT OF RESOURCES

The scope of the proposed action is small and the resources (material/ manpower) for construction and operation will likewise be small. No significant commitments of valuable resources are involved.

With the exception of the land area, all of the construction and operation-related material will be irrevocably committed to the implementation of the remedial action. Most of these resources are normally consumed at the plant at a rate which makes the requirements of the remedial action insignificant. While the resins and associated recharge chemicals may or may not be similar to resins and chemicals alreach in use at the RFP, it is expected that the resins and recharge chemicals will be readily available from offsite sources and that the volume of both resins and recharge chemicals used will not cause significant shortages in the business community. The hydrogen peroxide and the ultraviolet lamps are widely available outside of the plant and do not represent a significant cost or availability problem.

The resources irrevocably and irretrievably committed to this action are not sufficient to cause changes to the background supply and consumption patterns.

Table 5.6-1

RISKS TO THE GENERAL PUBLIC[3] FROM A TANK RUPTURE ACCIDENT

Volatile Organic Chemical	VOC Concentration (mg/l)	Source Term (mg/sec)	Air Concentration (mg/m^3)	Adult Risk[1] Carcinogenic	Adult Risk[1] Non-Carc.	Child Risk[1] Carcinogenic	Child Risk[1] Non-Carc.
Carbon Tetrachloride	4.59 E0[2]	6.57 E-1[2]	9.86 E-5	6.58 E-10	4.02%	7.67 E-10	4.69%
1,2-Dichloroethane	2.65 E0	3.90 E-1	5.86 E-5	1.02 E-10	0.23%	1.19 E-10	0.26%
1,1-Dichloroethene	9.56 E0	2.15 E0	3.22 E-4	1.22 E-8	1.02%	1.43 E-8	1.19%
t-1,2-Dichloroethene	1.65 E-1	1.08 E-1	1.63 E-5	--	0.05%	--	0.05%
Tetrachloroethene	9.31 E-1	6.12 E-1	9.18 E-5	1.53 E-2	0.13%	1.78 E-12	0.15%
Trichloroethene	3.90 E0	2.56 E0	3.84 E-4	1.35 E-1	1.49%	1.57 E-11	1.74%
TOTALS				1.30 E-8		1.52 E-8	

Exposure duration = 24 hours

Liquid flow rate = 10.417 gpm

Operating time adjustment = 1

1 See Appendix B, Specific Risk Estimation Terms.

2 4.59 E0 = 4.59×10^{0} = 4.59

6.57 E-1 = 6.57×10^{-1} = 0.657

3 In order to estimate the maximum exposure or risk to the general public, all estimates are based on the exposure to a person staying at the RFP site boundary (or wherever the air concentrations would be the greatest) 24 hours perday, 365 days per year.

5.8 TRANSPORTATION IMPACTS

Human health impacts normally incident to transportation include latent effects associated with vehicle pollution in addition to traumatic injuries and fatalities resulting from accidents.

Normal transportation is associated with incremental pollution from engine emissions, fugitive dust generation in the vehicle's wake, and particulates from tire wear. The table below presents estimates of risk (Rao, 1982) resulting from truck and rail transportation. Uncertainties are associated with pollution emission rates and atmospheric dispersion behavior. To compensate for these uncertainties, the analysis utilized conservative estimates for determining pollution health effects. Tabulated accident impacts are average values over all population zones (urban, suburban, rural) and are derived from Department of Transportation nationwide statistics.

		Health Effects per Kilometer		
Source	Transportation Mode	LCFs*	Injuries	Fatalities
Pollutants	Truck	1.0 E-7 (urban only)		
	Rail	1.3 E-7 (urban only)		
Accidents	Truck		5.1 E-7	3.0 E-8
	Rail		4.6 E-7	3.4 E-8

* LCFs represent latent fatalities resulting from incremental vehicle pollution.

The proposed action does not involve either on-site or off-site shipment of contaminated materials and consequently will not have any potential impacts associated with the transportation of contaminants. Excavated soils are to be distributed over the immediate area of the remedial action site and will not require shipment to another location. If, during construction activities, areas of localized radioactive contamination are identified and excavated as discussed in 5.5.1, the associated impacts due to transportation of the excavated material would be essentially the same as described in part 6.8.3 of this report. It is not anticipated that more than a single shipment would be involved so the attendant risks would not present a significant impact to the public.

The proposed action will involve transportation activities during the construction phase as well as during subsequent operation. All shipments are anticipated to be by truck and originate within the Denver metropolitan area and within a 50-mile radius of the plant site. Construction materials to be brought on-site include process treatment components, drain rock (7,334 yd^3), synthetic liners for the french drain (5,500 yd^2), concrete sumps, pumps, piping, and associated equipment. The delivery of these materials will require approximately 520 truckloads over a two-month period. The resulting transportation impacts will be small, as seen from health effect estimates (Rao, 1982). From the estimates it can be concluded that one fatality will result in approximately 5 million miles of travel. This is equivalent to 50,000 round trip truck shipments to the Plant from the Denver metropolitan area having a maximum one-way distance of 50 miles. The increase in site traffic will be noticeable, but will be of short duration. External to the plant boundary the increase in traffic level will not be noticeable.

Normal operation will require periodic delivery of hydrogen peroxide. Maximum process treatment consumption is expected to reach a peak of 2,200 gallons annually. Deliveries will be spread out over the course of the year and will likely be handled by one of the existing plant chemical suppliers. Transport and handling of hydrogen peroxide (classified as an oxidizer in DOT regulations) will be in accordance with applicable regulations and procedures. The very small number of shipments involved will result in an insignificant impact to human health.

Normal operation will also involve periodic delivery of recharge chemicals for the ion exchange resins and possibly infrequent shipments of replacement resins. There is no direct experience with the use of the resins for treatment of this water source, so no estimates of useful life of the resins or recharge frequency have been performed. The volume of water to be processed and expected average concentrations of inorganic chemicals are both modest. It is expected that the number of shipments required will be small and will result in an insignificant impact to human health.

5.9 CUMULATIVE IMPACTS

Routine water processing arising from the treatment of VOCs would create no significant solid wastes. The liquid and gaseous releases will be insignificant or undetectable. None of the materials that may be released are expected to be concentrated by any natural process. Therefore, releases from water treatment will not add to any other plant releases to have a cumulative effect. The reprocessing of resin recharge waste brine will result in an increase in load on the evaporator at Building 374 as well as add to the solids produced by this evaporator. Neither effect, however, is significant compared to the current loading and output of the evaporator, nor are the types of liquids input or solids output expected to be significantly impacted. When the resins need to be replaced or removed at the completion of processing, they will add an insignificant amount to the current solid waste to be disposed of at the plant. None of the chemicals to be collected on the ion exchange resins are defined as hazardous materials and uranium accumulation on the resins is not expected to exceed exempt quantities by weight, so shipping the exhausted resins is not expected to cause any special concerns or require special controls. There will be some redirection of flow from the 881 Building foundation drain that currently is released to the south interceptor ditch to be returned to Woman Creek via the alluvium through the reinjection trench following treatment. This would not, however, create a significant impact on the capability of the interceptor ditch to perform its designed function nor will the impact on Woman Creek be significant.

It is estimated that two workers will be involved for approximately two hours per day in routine operation and maintenance of the water treatment facility. This will have a negligible impact on the workload of the ordinary plant workforce. In routine operation, these workers will not be exposed to any levels of VOCs that would restrict them from other assignments at the Rocky Flats Plant.

Construction activities will result in increased vehicular traffic, engine emissions, and workers on-site. The 1980 Rocky Flats Plant Environmental Impact Statement notes a yearly loading of 300 additional construction personnel on average. The number of personnel required for the proposed action will be an insignificant portion of this assumed yearly construction loading.

Excavation for the french drain may surface small amounts of VOC-contaminated soils, as discussed in section 5.5. The airing of such soils will create temporary low-level releases of contaminant vapors to the atmosphere. Monitoring will be performed at the pile in accordance to the Job Safety Analyses. It is unlikely that any measurable concentrations of vapor will be found since the pile will be in an unconfined air space. The amount of vapor thus released will be an insignificant addition to the total releases from the plant site.

The water treatment facility is to be installed in a pre-existing structure, and no additional land will be required. Local traffic may be temporarily disrupted by the trenching for underground piping from collection points to the water treatment facility. These disruptions would be short (a day) and occur in low traffic areas.

6.0 ENVIRONMENTAL EFFECTS OF ALTERNATIVES

6.1 TRANSPORTATION OVERVIEW

Major quantities of materials to be shipped for each alternative retained for environmental assessment evaluation, as well as a summary of related transportation activities, are presented in Table 6.1.1. It is anticipated that bulk material shipments would be made with haul trucks having a 15 yd^3 capacity, any on-site transport of contaminated groundwater would be by dedicated 7,500 gal tanker trailer, and that any excavated materials would be retained on-site and utilized as fill material at the remedial sites and would not require transport to another location. A comparison of potential transportation impacts of the proposed action and alternatives is summarized in Table 6.1.2. Due to the relatively small size of construction/operation associated with the alternatives, impacts on plant traffic levels from construction equipment movement and support personnel would be minimal and would not vary significantly among alternatives.

As presented in Section 5.8, estimates of health effects resulting from transportation have been evaluated (Rao, 1982). The hazardous nature of the cargo being transported is another factor that must also be considered. Quantities and concentrations of contaminated materials to be shipped by the various alternatives are quite small compared with the estimated 100 million shipments of hazardous commodities made annually within the nation and will have negligible impacts on a local or regional basis. Any such shipments would be in accordance with applicable regulations (e.g., DOT, DOE).

If, during construction activities for any of the alternatives, areas of localized radioactive contamination are identified and excavated as discussed in 5.5.1, the associated impacts due to transportation of the excavated material would be essentially the same as described in part 6.8.3 of this report. It is not anticipated that more than a single shipment would be involved so the attendant risks would not present a significant impact to the public.

Assuming local truck shipments of bulk materials originate within a 50 mile radius of the plant and that travel is primarily within the metropolitan area, risks associated with one shipment (round trip) would be:

		Chance of one additional death from the risk
Latent Cancer Fatalities*	- 1.6×10^{-5}	1 in 62,500
Traumatic Injuries	- 8.2×10^{-5}	1 in 12,200
Traumatic Fatalities	- 4.8×10^{-6}	1 in 208,000

* from increased vehicle pollution

6.2 ENVIRONMENTAL EFFECTS OF NO ACTION

6.2.1 Environmental Quality

There are no current indications of contaminant impacts on the plant and animal life of 881 Hillside (Rockwell International, 1988c). Local groundwater exhibits significant contamination and this contamination is slowly migrating, though no offsite contamination has been found.

The no action alternative would require that the current semi-annual site monitoring be continued. Since the monitoring is a part of the existing plant environmental monitoring program, the impact on plant operations and the surrounding community would be effectively zero. However, because offsite migration may occur in the future and because federal and state regulations require remedial action, the no action alternative is unacceptable.

6.2.2 Personnel Exposure

The no action alternative will have minimal impact on current workers at the site or at adjacent sites. Workers would be required only for semi-annual sampling, which would present no additional impacts. The source of hazardous material would be neither removed nor controlled. Therefore, the possibility of releasing contaminated water offsite would increase over time. The site would then be a source of public exposure in the long-term.

Table 6.1.1

SUMMARY OF REMEDIAL ACTION ALTERNATIVE TRANSPORTATION PARAMETERS

Alternative	Material to be Transported	Estimated[1] Volume of Material (yd^3)	Estimated[2] Number of Truck Shipments	Comments
No Action	None	0	0	No transportation involved.
Immobilization	Grout	920	61	Shipments would occur only during construction phase.
	Grout Pipe/ Drilling Equipment	--	10	
Total Encapsulation	Slurry Wall Material	1,685	112	Shipments would primarily occur during the construction phase. Would involve on-site shipments of contaminated groundwater. Bentonite for the slurry wall will come from Wyoming, involving longer trips than for most other materials.
	Cap Material			
	- compacted soil	3,407	227	
	- drain rock	851	57	
	- top soil	850	57	
	Misc. (e.g., pumps/ sumps, fabric)	--	10	
	Collected Contaminated Groundwater	--	50 initially 1 annually	
Source Well and Footing Drain Collection with Treatment	Treatment Plant Equipment	--	20	Shipments would primarily occur during the construction phase. Periodic shipments of treatment consumables would be required during operation.
	Treatment Plant Consumables	--		
	- hydrogen peroxide		2-3 annually	
	Drain Rock	3,667	245	
	Sump Pump/Misc. Equip.	--	10	

Table 6.1.1 (cont.)

Alternative	Material to be Transported	Estimated[1] Volume of Material (yd^3)	Estimated[2] Number of Truck Shipments	Comments
Comprehensive Well Array and Treatment	Treatment Plant Equipment	--	20	Shipments would primarily occur during the construction phase, with periodic shipments of treatment consumables.
	Treatment Plant Consumables - hydrogen peroxide		2-3 annually	
	Drain Rock	3,667	245	
	Well System Equip.	--	15	
French Drain and Soil Flushing	Treatment Plant Equipment	--	20	Transportation activities similar to proposed action, but a larger number of shipments are required due to the addition of a leach field.
	Treatment Plant Consumables - hydrogen peroxide		2-4 annually	
	Drain Rock	11,501	767	
	Sump/Pump, Drain and Misc. Equipment	--	15	
French Drain and Partial Excavation	Treatment Plant Equipment	--	20	Would require off-site shipments of contaminated soil to a RCRA disposal facility. Would also involve on-site shipments of contaminated groundwater.
	Treatment Plant Consumables - hydrogen peroxide		2-3 annually	
	Drain Rock	7,334	489	

Table 6.1.1 (cont.)

Alternative	Material to be Transported	Estimated(1) Volume of Material (yd^3)	Estimated(2) Number of Truck Shipments	Comments
	Pump, Drain, and Misc. Equipment	--	10	
	Excavation of Contaminated Soil	2,909	200	
	Backfill	2,909	200	
	Collected Contaminated Groundwater	--	6	

Notes: (1) Material volume estimates are based on Feasibility Study Report for high priority sites (881 Hillside Area), March 1, 1988.

(2) Assumes 15 yd^3 capacity for haul trucks and 7,500-gal tanker trailer capacity for on-site shipments of contaminated water.

Table 6.1.2

COMPARISON OF POTENTIAL TRANSPORTATION IMPACTS OF PROPOSED ACTION AND ALTERNATIVES

	Transportation Activities During		Requires Transport of Contaminated Material		
Alternative	Construction	Operation	On-Site	Off-Site	Transportation Impacts
Proposed Action	Base Case	Base Case	None	None[1]	Requires approximately 520 truck shipments and occasional receipt of process treatment consumables. No significant transportation impacts result.
No Action	None	None	None	None	Involves no transportation impacts.
Immobilization	Less	None	None	None[1]	A total of 71 truck shipments would be required. Transportation impacts would be negligible.
Total Encapsulation	More	None[2]	Yes	None[1]	Requires approximately 460 truck shipments. On-site transfer of contaminated groundwater would also be required -- up to 50 truck shipments initially and one per year subsequentially. No significant transportation impacts would result.
Source Well and Footing Drain Collection with Treatment	Less	Same	None	None[1]	Involves approximately 275 truck shipments and receipt of occasional shipments of process treatment consumables. Transportation impacts would be negligible.

Table 6.1.2 (cont.)

Alternative	Transportation Activities During		Requires Transport of Contaminated Material		Transportation Impacts
	Construction	Operation	On-Site	Off-Site	
Comprehensive Well Array and Treatment	Less	Same	None	None[1]	Requires approximately 280 truck shipments and periodic receipt of process treatment consumables. Transportation impacts would be negligible.
French Drain and Soil Flushing	More	Slightly Higher	None	None[1]	Involves approximately 802 truck shipments and periodic receipt of process treatment consumables. Incorporation of a leach field increases the number of shipments by 277. No significant transportation impacts would result.
French Drain and Partial Excavation	Greatest	Same	Yes	Yes	Requires approximately 925 truck shipments of which 6 would be on-site to transfer contaminated groundwater and 200 would be off-site to dispose of contaminated soil. No significant impacts would result.

1. If localized radioactivity contamination is found, there may have to be one off-site shipment.

2 No periodic shipments of process treatment consumables would be required.

The Risk Assessment quantifies the risks to members of the public for each of two scenarios within the no action alternative: Scenario A assumes residential construction on the plant site (loss of institutional control); Scenario B assumes residential construction at the plant boundary (contaminated water pathway). Table 6.2.1 summarizes the carcinogenic risks as given in the Risk Assessment. Table 6.2.2 summarizes the pathways involving exposures which would exceed Acceptable Chronic Intakes, as identified in the Risk Assessment. It is clear from these two tables that both types of risks are above acceptable limits.

6.2.3 Transportation

The no action alternative would incorporate both groundwater and surface water monitoring and utilize existing wells. No remedial activities would be taken. Consequently, there would be no on-site or off-site transportation activities associated with this alternative or related occupational or non-occupational health impacts. In comparison, the proposed action will require rock/gravel truck shipments to backfill the drain trench during construction and periodic shipments of hydrogen peroxide during operation. As discussed in Section 5.8, these transportation impacts are negligible, but will be greater than those resulting from the no action alternative. Neither the no action alternative nor the proposed action involve shipments of contaminated material.

6.3 ENVIRONMENTAL EFFECTS OF IMMOBILIZATION

6.3.1 Environmental Quality

The construction phase of this activity will result in significant surface and sub-surface impacts to the immediate areas of SWMU 107 and 119.1. The impacts would be temporary but extensive, resulting in a loss of all existing flora and fauna on the sites. Following revegetation, the site will quickly return to its present state.

Table 6.2.1

CARCINOGENIC RISKS ASSOCIATED WITH THE NO ACTION ALTERNATIVE

	Estimated Total Lifetime Carcinogenic Risk	
	Average Exposed Individual	Maximally Exposed Individual
Scenario A Residential Construction On Site	1.53 E-1[1]	2.16 E0
Scenario B Residential Construction At Site Boundary	4.04 E-3	5.66 E-2

1. $1.53 \text{ E-1} = 1.53 \times 10^{-1} = 0.153$

Data taken from (Rockwell International, 1988b), Tables 5-10 through 5-13.

Table 6.2.2

EXPOSURE PATHWAYS IN WHICH ESTIMATED DAILY INTAKE
EXCEEDS ACCEPTABLE CHRONIC INTAKE
NO ACTION ALTERNATIVE

Indicator Chemical	Scenario A				Scenario B			
	AA	AC	MA	MC	AA	AC	MA	MC
Carbon Tetrachloride	X	X	X	X	X	X	X	X
1,2-Dichloroethane	X	X	X	X			X	X
1,1-Dichloroethene	X	X	X	X		X	X	X
t-1,2-Dichloroethene		X	X	X				X
Tetrachloroethene	X	X	X	X				X
Trichloroethene	X	X	X	X		X	X	X
Nickel			X	X				
Selenium	X	X	X	X				X
Strontium	X	X	X	X	X	X	X	X
Uranium		X	X	X				

AA = Average Adult Exposure
AC = Average Child Exposure
MA = Maximally Exposed Adult
MC = Maximally Exposed Child

Taken from (Rockwell International, 1988b), Table 5-26.

The drilling process will bring significant amounts of sub-surface soils from within the SWMU boundaries to the surface. These soils could become a potential erosion problem, although soil erosion control required because of the contaminants carried with the soil should prevent this.

The drilling of 460 wells averaging 10 feet in depth, and grout injection will require drilling rigs, injection equipment, bits and well casings, several operators, fuels, lubricants, and grout material. Following the construction phase, decontamination will have to occur to the drilling rig and grout injection equipment. While still within the Environmental Impact Statement (EIS) estimates of additional yearly construction loading and insignificant against the urban construction background (DOE, 1980), this alternative's manpower and non-renewable resource requirements are several times greater than those of the proposed action.

There is doubt that a grouting operation could be successful due to the stratified and fine-grained soils characteristic of the sites. According to State and Federal regulations, the site could not be released for use by the general public until the levels of contaminants are below the levels stated in the regulations. Since this alternative does not include a mechanism for reducing the levels of contaminants, the land could not be released for public use.

6.3.2 Personnel Exposure

Immobilization will require installing shallow wells throughout the SWMUs. Many of these will be located in areas of greatest underground contamination. Workers will therefore have potential exposures to both VOCs and low-volatility organics during the well-drilling operations. Because the amount of soil and water exposed at any time is small, airborne exposures would most likely be limited, although monitoring would have to be provided to verify that airborne levels were not of concern. Protection would be required to control dermal exposures to organics. Dermal exposures to inorganics would not pose significant risks.

Risks to the general public from VOCs would be less than french drain excavation because of the limited amount of soil and water exposed and available for volatilization. As with the proposed action, inorganics would not provide significant risks to the general public population during installation operations.

Because the contaminants are not removed by this alternative, there may be a potential exposure of the general public in the future if there is the loss of institutional control of the area followed by excavation in the area.

6.3.3 Transportation

The immobilization alternative would involve transportation activities during the construction phase. Over this period of time, materials to be shipped to the plant site include drilling equipment, grout pipe, and grout. Table 6.1.1 estimates that a total of approximately 70 truck shipments would be required to implement this alternative. While this would involve substantially fewer truck shipments than the proposed action, transportation risks would remain comparably small due to the very small health effects associated with the shipments. This alternative does not require transport of contaminated material.

6.4 ENVIRONMENTAL EFFECTS OF TOTAL ENCAPSULATION

6.4.1 Environmental Quality

The bentonite slurry wall and RCRA cap will require approximately forty percent more bulk construction materials (soils and drain rock) than the proposed action but will be less labor-intensive and simpler to install. Construction impacts, while destructive to the site's immediate flora and fauna, will be roughly equivalent to that of the french drain and equally short lived. As with the grouting, the activity will be focused on a smaller area and thus less intrusive than the french drain construction.

Both labor and materials requirements will be supplied by local sources. Project requirements for labor and materials are insignificant.

Soils used in cap construction will be brought in from off site. There will be a brief period during which there may be pollution of surface waters due to soil erosion until the vegetative cover is replaced but the drain rock and the short construction period will limit the impact substantially. There will be a change in land contour amounting to the addition of four feet of cover over the entirety of the two SWMUs.

The encapsulation alternative will remove a great deal of the contaminated groundwater in the process of initial and subsequent annual dewatering operations. While the purpose of the dewatering is to assist contaminant containment, a beneficial side effect will be to essentially decontaminate the area that has been encapsulated. The effective decontamination, however, will not be nearly as thorough as the proposed action and will not directly handle the destruction of the contaminants. Contaminants which have already migrated out of the SWMU boundaries will not be captured at all, a disadvantage over the proposed action but not a significant one, as migration has not been detectable in Woman Creek. The lack of contaminant removal or neutralization could result in a lengthening of the period of required institutional control.

6.4.2 Personnel Exposure

Because the installation of Bentonite walls would be performed outside of those areas with the potential of significant contamination, installation of the walls will not involve increased risks for either workers or the general public. Furthermore, it is not expected that excavation for the cap would be deep enough to involve significantly contaminated soil.

The initial and repeated dewatering operations within the contaminated area would provide the potential for worker contamination. Contamination levels in the dewatering liquids would most likely be considerably higher than the processing liquids involved in the proposed action, although the total amount of liquid would be lower.

Because encapsulation isolates but does not treat or remove the contaminant source, future exposures may become possible with the loss of institutional control of the land. Activities that compromise the integrity of the cap or walls may lead to exposures, either by leading to direct contact (as with excavating, etc.) or the re-introduction of water permitting a liquid pathway for exposure.

6.4.3 Transportation

The total encapsulation alternative would have negligible transportation impacts, though it would entail somewhat more truck shipments than the proposed action and would involve on-site transfer of contaminated groundwater. Table 6.1.1 estimates that approximately 450 truck shipments would be required to support construction of the slurry wall and RCRA cap and that this would occur over approximately a three-month period. Incorporation of a sump at SWMU 107 and 119.1 to maintain a hydraulic gradient towards each encapsulated area will result in collection of contaminated groundwater. This will require transfer by truck to an existing Rocky Flats Plant treatment facility. Transfer of the collected groundwater would likely be required during the initial dewatering phase, when each SWMU sump pump would first become operable, with subsequent on-site shipments occuring on an annual basis. All transportation of contaminated groundwater would be within plant boundaries using established roadways that are DOE controlled and for a distance of less than one mile to the existing treatment facility. Handling and transportation of the contaminated ground water would be in accordance with applicable regulations and plant procedures using on-site equipment. The location, limited number of shipments, and procedural controls implemented would effectively eliminate any public health effects associated with contaminated groundwater handling and transportation and minimize related occupational impacts.

6.5 ENVIRONMENTAL EFFECTS OF SOURCE WELL AND FOOTING DRAIN COLLECTION WITH TREATMENT

6.5.1 Environmental Quality

The near-term environmental impacts of this alternative are small, as the only new construction necessary is a collection sump at the SWMU 107 drain outfall, the effluent reinjection trench, and associated piping trenches. The conversion of an existing structure to a treatment facility is perhaps the most significant effort, but that will occur in a previously developed area easily accessed and already heavily traveled.

The materials and manpower requirements will be less than half that of the proposed action and insignificant in the local markets for these materials.

The piping trenches, footing drain collector, and leach field will comprise the total excavation requirements of this project. There will be little or no excess soils or uncovered soil areas to produce erosion, and there will be no noticeable change in land contour.

This alternative has little effect on the migration potential of the hazardous materials. It does remove the major contaminant media and destroys the contained contaminants. However, it will only address identified pockets and not the contamination problem as a whole, allowing downgradient contaminants to continue migrating. This alternative relies on the assumption that the lower concentrations of remaining contaminants will be diluted to insignificant levels by the time offsite migration occurs.

6.5.2 Personnel Exposure

By not including the french drain (as in the proposed action), the risks from operation and/or accident scenarios are affected in two ways. A portion of the contaminant plume hydrologically downstream will not be collected or treated, reducing the total contamination processed and thus reducing, to an indeterminant degree, the risk involved for both workers and general public. Without the flow from the french drain, which will be of much lower concentration than the source well, the concentration of the collected influent will be higher. This will increase the effects of any system leakage and influent tank vent releases. It may impact the processing efficiency of the treatment facility. Assuming the tank rupture accident scenario involves a similar total volume of liquid as was used in the analysis for the proposed action, impacts on off-site personnel would be greatly increased.

The potential for future releases via the groundwater would remain, although the eventual release levels would be lower than in a no action scenario. Because the draw-down of the water table by the single well would not be likely to extend adequately throughout the region of contaminated groundwater, there would remain the potential for exposures similar to but less than those described in Appendix 1 of the Feasibility Study or the no action alternative. The amount of contaminated groundwater would be decreased by this alternative, so the risks would be lowered but not eliminated.

6.5.3 Transportation

As with the proposed action, this alternative would involve periodic delivery of hydrogen peroxide to the plant site. As indicated in Table 6.1.2, the number of shipments during construction would be about the same as the proposed action, and there would be no significant difference in transportation risks. As with the proposed action, shipment of contaminated material would not be required.

6.6 ENVIRONMENTAL EFFECTS OF COMPREHENSIVE WELL ARRAY AND TREATMENT

6.6.1 Environmental Quality

The overall environmental impacts of the source well array alternative would be essentially the same as for the proposed action. However, it would not match the proposed action's effectiveness in cutting off groundwater flow from the hillside. Risk of contaminant migration via groundwater would be significantly reduced, but not to the extent offered by the proposed action.

The requirements of materials and manpower will be similar to the proposed action although biased more towards equipment (pipes, valves, pumps) and less towards the locally available bulk fills. The equipment needed is available and easily transported due to small size. Existing suppliers and transporters should be able to respond without expansion of capacity or distortion of existing trade patterns.

As with the proposed action, this alternative intercepts the migrating hazardous materials at the base of the hillside. Spot sources at the SWMU 107 footing drain and SWMU 119.1 source well will be removed directly;

contaminants already downgradient of those collectors will be handled by the source well array. While effective, it will not be as effective (not providing a positive cut-off) as the french drain and impermeable membrane at approximately the same cost.

6.6.2 Personnel Exposure

The risks to personnel, both workers and general public, would be nearly the same for a series of dewatering wells as for the french drain of the proposed action. Installation risks would be somewhat decreased, but those risks are not significant in the proposed action. Exposure to workers during operation of the system could increase slightly as there would be an increase in the number of pumps that might require maintenance.

6.6.3 Transportation

Incorporation of interceptor wells in this alternative minimizes excavation work and related transportation activities. As with the source well and footing drain collection with treatment alternative, there would be about the same number of shipments as the proposed action. The comprehensive well array alternative would treat any collected groundwater in a new treatment plant. As noted in Table 6.1.1, this would require periodic delivery of process treatment consumables. Transportation impacts would not be very different than the proposed action. Shipment of contaminated material would not be required for this remedial action alternative.

6.7 ENVIRONMENTAL EFFECTS OF FRENCH DRAIN AND SOIL FLUSHING

6.7.1 Environmental Quality

The Soil Flushing alternative adds excavation and leach field construction on SWMU 119.1 to the proposed action. The addition of soil flushing slightly more than doubles the drain rock and PVC pipe consumption of the Proposed Action; however, the increased amounts of these commodities remain insignificant relative to the local market for these materials.

As part of the drain field installation, soils above the SWMU will be excavated and relocated to portions of the SWMU to decrease the present rate of slope of the surface to enhance drain field performance.

The excavation of soils above the SWMU will be temporarily destructive to local flora and fauna. There will also be the possibility of an erosional soil pollution to surface waters, particularly since the excavation will be into the SWMU itself. However, the top layer of soils does not show significant contamination, and the risk of contaminant erosional migration and volatilization is small. A significant reduction in the remediation period would be realized by the alternative's enhanced removal rate for volatile organics.

6.7.2 Personnel Exposure

Adding soil flushing to the proposed action will not change the possible effects on the non-worker population. The construction of the leach field, while involving excavation of approximately the same volume of soil as the installation of the french drain, would be expected to involve less risk to both the workers and the general public. The excavation is expected to be relatively shallow and should not involve soils below the water table, so volatile organic chemicals, which are confined to the groundwater, would not be of concern for either workers or non-workers. The only hazardous materials found in the soil that may pose a concern for dermal or contact uptakes are low volatility organic chemicals. It is not expected that levels of such chemicals would be significantly higher than those analyzed in Section 5.5 for french drain installation, where the risks were found to be a factor of a thousand below levels of concern. Ordinary dust control measures will be adequate to prevent exposures of either workers or general public to inhalation of fugitive dusts.

It is not expected that risks to possible future populations would be significantly different than with the proposed action.

6.7.3 Transportation

Transportation activities for this alternative and related impacts would be approximately fifty percent greater than the proposed action. This is due to the incorporation of a leach field at SWMU 119.1 and would require transport of additional quantities of drain rock. Table 6.1.1 summarizes shipment requirements for this alternative. Even with these additional shipments, transportation risks would remain insignificant, due to the very small health effects associated with them. Periodic shipments of process treatment consumables are anticipated to be greater than the proposed action because of the use of soil flushing technologies. However, this will shorten the time that treatment is required, such that related transportation impacts would be comparable to the proposed action. As with the proposed action, there would be no transport of contaminated material.

6.8 ENVIRONMENTAL EFFECTS OF FRENCH DRAIN AND PARTIAL EXCAVATION

6.8.1 Environmental Quality

The proposed action would be enhanced through the removal of approximately 3,000 cubic yards of soil from a circular area around the SWMU 119.1 source well. This alternative differs significantly from the others in the excavation and off-site disposal of media containing hazardous materials.

The necessary transportation, excavation equipment, and personnel are available locally without resulting in a significant impact to the local market. Partial excavation occurs in conjunction with french drain construction so overall activities compared to the proposed action would be increased. Fill material requirements would increase. Local sources and transporters are available without distorting the local markets.

A facility which is both permitted and willing to take the excavated soils would have to be located and arrangements made for decontamination of equipment used in the excavation. In both cases significant amounts of hazardous materials would simply be transferred to another location.

6.8.2 Personnel Exposure

Because the more concentrated liquids from the source well add significantly to the calculated risks from both influent tank vent discharges and potential accident scenarios, the removal of that source would lower estimates of risk to the general public for both operation and accident conditions compared to the proposed action. However, these risks are small for the proposed action, so this risk reduction is not significant.

During the partial excavation, the exposure to both workers and the general public would be substantially increased over the proposed action. The french drain installation would remain the same but because the partial excavation involves the most highly contaminated soils, the release of volatile organic chemicals would be substantially higher. It is expected that both direct dermal contact control and respiration protection controls would be required for the workers involved in most of the excavation. Potential risks to the general public would be increased by the airborne VOC level increases. Shipping of the contaminated soils to an approved site would involve increased transportation risks over the proposed action, but these risks would still be small.

Because excavation would remove both contaminated liquid and contaminated soil, future exposure risks from chemicals in the soil (which are not treated by the proposed action) would be reduced. However, the future risks from chemicals in the soil were not found to be significant in the Risk Assessment (Feasibility Study, Appendix 1) which assumed no soil treatment.

6.8.3 Transportation

The french drain with soil removal alternative would result in over three times the number of shipments as the proposed action, including a small number of on-site shipments of contaminated groundwater to an existing treatment facility and several off-site shipments of contaminated soil to a disposal facility permitted to receive hazardous waste material.

Contaminated groundwater would be collected as a result of inflow to the excavation area during construction and would be temporarily stored in an adjacent on-site tank. It is estimated that up to 6 tanker truck loads would be required to transfer the collected water to an existing treatment facility. As with the other alternatives involving transport of contaminated ground water, all shipments would be within plant boundaries using Department of

Energy-controlled roadways and in accordance with applicable regulations and plant procedures. Transport distance to the treatment facility would be approximately one mile, using established roadways. Based on transportation health effect studies (Rao, 1982), these on-site shipments would have negligible impacts associated with incremental vehicle pollution and traumatic injuries and fatalities. The location, limited number of shipments, low contamination levels, and procedural controls implemented would effectively eliminate any public health effects associated with contaminated groundwater handling and transportation and would minimize related occupational impacts.

Soil contaminated with hazardous chemicals and/or radioactive material will be sealed in wooden boxes lined with polyethylene. These will be transported on sole-use vehicles. All shipments would be in accordance with applicable procedures and transportation regulations to minimize any potential health effects associated with the cargo. Contaminant and moisture levels would be required to be monitored and appropriate use of controls and absorbents be utilized. This environmental assessment assumes that the contaminated soil would be shipped to the Nevada Test Site (NTS) for disposal. The facility is located approximately 65 miles northeast of Las Vegas in Nye County, which is in southern Nevada. The most direct route that maximizes interstate highway usage from Rocky Flats Plant to NTS is approximately 880 miles with a one-way travel time of about 20 hours. Fractions of travel in the population zones would consist of 1% urban (3861 persons/km^2), 7% suburban (719 persons/km^2), and 92% rural (6 persons/km^2) (ORNL, 1983). Based upon transportation health effect estimates (Rao, 1982), risks associated with one round trip shipment would be:

		Chance of one additional death from the risk
Latent Cancer Fatalities*	- 1.3×10^{-6}	1 in 770,000
Traumatic Injuries	- 6.6×10^{-4}	1 in 1,500
Traumatic Fatalities	- 1.5×10^{-5}	1 in 67,000

* From incremental vehicle pollution

Consequently, health effects resulting from the traffic of approximately 200 truck trips would not present a significant impact to the public.

APPENDIX A - RISK ESTIMATION TECHNIQUES

Carcinogenic risks are calculated to estimate the increased likelihood of the individual contracting a carcinogenic disease during his lifetime due to the uptake being evaluated.

Risk Estimate = daily uptake x CPF x EDA

CPF = Carcinogenic Potency Factor, as defined in Superfund Public Health Evaluation Manual (EPA)

EDA = Exposure Duration Adjustment

The calculation of the CPF was based on lifetime chronic exposure to the hazard. If exposure to the risk factor is less than 70 years, an adjustment is made to account for the decreased duration. It is calculated as:

$$EDA = \frac{\text{duration of exposure (years)}}{\text{70 years}}$$

For adults, that is 30/70. For children, there are two components: the first five years when children's body mass and breathing rate are used for analysis (5/70) and the remaining twenty-five years when it is assumed the breathing rate and body mass are equal to those of an adult (25/70). The total lifetime risk of a child is the combined risks for these two components.

Non-carcinogenic Risks (acute exposure)

Non-carcinogenic risk assessment is made by comparing the daily uptake to an uptake level (called the Health Effects Criterion) below which it is not expected that any health effects are likely to occur.

$$\text{Risk Assessment} = \frac{\text{Daily Uptake}}{\text{Health Effects Criterion}}$$

$$\underset{(\text{mg/kg-day})}{\text{Daily Uptake}} = \frac{\text{Airborne Conc. x Breathing Rate x ETA}}{\text{Body Mass}}$$

Airborne Concentration (mg/m^3) = Calculated average concentration in air at the point of exposure (the site boundary)

Breathing Rate = 20 m^3/day (adult)
= 5 m^3/day (child)

Body Mass = 70 kg (adult)
15 kg (child)

ETA = Exposure time adjustment

$$= \frac{\text{hours the source is releasing}}{24} \times \frac{\text{days source is releasing}}{7}$$

Airborne Concentration = Release Source Term x X/Q

X/Q = dispersion factor
= 1.5 E-4 sec/m^3 for worst case conditions (1 m/sec wind speed, Pasquill stability class F, 1.9 km source to receptor distance)

$$\underset{(\text{mg/sec})}{\text{Release Source Term}} = \frac{\text{flow rate (gal/min) x source conc. (mg/l) x 3.7853 l/gal}}{\text{60 sec/min}}$$

Table A-1 lists the indicator Volatile Organic Chemicals (VOCs) and their related values for CPF and HEC as found in Appendix 1 of the FS.

Table A-1

VOLATILE ORGANIC CHEMICAL PARAMETERS

VOC	Cancer Potency Factor[1]	Health Effects Criteria[1]
Carbon Tetrachloride	1.30 E-1[2]	7.00 E-4
1,2-Dichloroethane	3.50 E-2	7.43 E-3
1,1-Dichloroethene	1.16 E-0	9.0 E-3
t-1,2-Dichloroethene	--	1.00 E-2
Tetrachloroethene	9.63 E-3	2.00 E-2
Trichloroethene	5.45 E-2	7.35 E-3

1 See Appendix B, Specific Risk Estimate Terms

2 1.30 E-1 = 1.30×10^{-1} = 0.13

APPENDIX B - SPECIAL TERMS USED IN THIS REPORT

Contaminant

In the context of this report, contaminants refer to the hazardous substances (as designated in 40CFR116) or radioactive material found in air, water, or soil in quantities in excess of it's occurrence in the local environment or in excess of applicable regulations.

General Public

In calculating risks to the general public in this report, the estimates of exposure are performed considering an appropriate individual (i.e., child or adult) that is presumed to remain at the point of highest potential exposure (usually the site boundary) at all times - 24 hours per day, 365 days per year - and makes ordinary use of the contaminated media to the greatest extent possible. For example, this hypothetical individual could breath only air at the maximum contamination level that might reach the site boundary or eat vegetables from their garden which is assumed to be planted at the point of highest exposure to contaminants and watered with water as released from the plant site. Thus, the estimate of exposure or risk to the general public represents the maximum a member of the general public could receive, not what any segment of the population might be expected to receive.

Hazardous Chemical

Any chemicals designated as a hazardous substance by federal regulations as found in the Code of Federal Regulations, Title 40, Part 116.

Institutional Control

As used in this report, institutional control refers to administrative and legal control over a specified portion of land such that access to and use of the land is maintained by a recognized agency of the government.

Carcinogenic Risk

Carcinogenic risk or cancer risk level provides an estimate of the additional incidence of cancer that may be expected in a population exposed to a given contaminant. A risk of 10^{-5}, for example, indicates a probability of one additional case of cancer for every 100,000 people exposed. A risk of 10^{-6} indicates one additional case of cancer for every one million people exposed. A risk of 10^{-7} would be one case in 10 million people exposed (EPA, 1985a).

The carcinogenic risk posed by exposure to a chemical depends upon three factors; dosage (estimated daily intake), the carcinogenic potency of the chemical, and the exposure duration.

The carcinogenic potency of a substance depends, in part, upon its route of entry into the body (e.g., ingestion, inhalation, or dermal). Therefore, potency factors are classified according to the route of administration that is applicable to the experimental or epidemiological data from which they were derived. The EPA has developed potency factors for the oral and/or inhalation routes for some carcinogens.

The length of exposure to a chemical must also be taken into account in the calculation of carcinogenic risk since carcinogenic potency factors are based on an exposure duration of 70 years (average lifetime exposure), and carcinogenic risk is assumed to be proportional to exposure duration (Rockwell International, 1988b).

Noncarcinogenic Risk

The noncarcinogenic risk is the estimate of whether a given concentration of a chemical may cause a non-cancerous health effect in an individual exposed to it.

Noncarcinogenic risk was evaluated by comparing predicted contaminant daily intakes to Health Effects Criteria (acceptable chronic intakes (AICs) or their equivalent). It is important to note that the approach used in assessing potential noncarcinogenic health effects, unlike the approach used in the evaluation of carcinogenic risk in Section 5.1, is not a measure of, and cannot be used to determine, quantitative risk (i.e., it does not predict the relative likelihood of adverse effects occurring). If the estimated daily intake of a contaminant exceeds the applicable health criterion (i.e., the ratio exceeds one) it indicates that there is a potential for noncarcinogenic health effects occurring under the defined exposure conditions. Because health criteria incorporate a margin of safety, exceedance of a criterion does not necessarily indicate that an adverse effect will occur.

Another difference between the evaluation of noncarcinogenic and carcinogenic risk is that the noncarcinogenic risk analysis does not take the duration of chronic exposure into consideration. Although the acceptable chronic intakes (AICs) are based upon a lifetime exposure, it is generally assumed that any chronic exposure, regardless of the duration, might potentially result in adverse effects if the health criterion is exceeded. Therefore, the assessment of noncarcinogenic risk for the child is carried out separately from, and is not additive to, the assessment for the adult.

The differences in methodology used in assessing noncarcinogenic and carcinogenic risk are based on the assumptions that noncarcinogenic health effects are threshold phenomena, whereas carcinogenic risk is not. This approach for evaluating carcinogenic risk conservatively assumes that for a carcinogen, exposure to even a small number of molecules (possibly even a single molecule) might potentially cause cellular changes that can result in cancer. For noncarcinogens, however, the assumption is made that a threshold level of intake must be exceeded before the potential exists for adverse health effects. AICs are recommended thresholds which should not be exceeded (Rockwell International, 1988b).

Comparison to Other Risks

All human activities are associated with some degree of risk. For the sake of perspective, the risk of death associated with various occupations, personal habits, lifestyles, and accidents are presented in Figure B-1.

Figure B-1

PUTTING RISK IN PERSPECTIVE

RISK OF DEATH	OCCUPATION	LIFESTYLE	ACCIDENTS	ENVIRONMENTAL RISKS
1 E-2 or 1 in 100	STUNTMAN			
1 E-3 or 1 in 1000	RACE CAR DRIVER	SMOKING One pack/day	ROCK CLIMBING	
1 E-4 or 1 in 10,000	FARMER		DRIVING MOTOR VEHICLE ALL HOME ACCIDENTS FREQUENT AIR TRAVEL	
1 E-5 or 1 in 100,000	TRUCK DRIVING ENGINEER	USING CONTRACEPTIVE PILLS	SKIING HOME FIRE	LIVING DOWNSTREAM OF A DAM NATURAL BACKGROUND RADIATION
1 E-6 or 1 in 1,000,000		DIAGNOSTIC X-RAY	FISHING OCCASIONAL AIR TRAVEL (1 flight/year)	
1 E-7 or 1 in 10,000,000		EATING CHARCOAL-BROILED STEAK		
				ANIMAL BITE OR INSECT STING

Source: (Rockwell International, 1988b)

APPENDIX C - SOURCE CONCENTRATIONS

The estimation of the release source term (see Appendix A) requires an estimated liquid concentration. The liquids for treatment are collected from three primary sources: the collected liquid from the 881 Building footing drain, the newly-installed french drain, and the source well (sample well 9-74). The average concentrations assumed for each source are shown in Table B-1. The concentrations for the source well are the maximum concentrations of the indicator chemicals in the alluvial groundwater as found in Table 4-1 of Appendix I of the FS. The average alluvial groundwater concentrations from the same table were used for the concentrations of the water from the french drain. The concentrations of VOCs reported in the 881 Building footing drain have been insignificant compared to other sources, so all the VOC concentrations for that source are assumed to be zero. The average collected concentrations were estimated using a weighted averaging technique for each VOC:

$$\text{Avg. Conc.} \quad = \quad \frac{\sum \text{(individual source conc. x source flow)}}{\sum \text{individual source flow}}$$

For the average processing liquid, the individual source flows used were the expected, long-term design flows used in the FS. The concentrations used in the emergency assessment were calculated using the higher flows expected when the liquid collecting is initiated. The minimal 881 Building footing drain volumes were used in both cases to minimize the dilution of the other liquids collected.

The VOC release rate from the vented influent tanks was estimated assuming the tanks to be partially filled with the average processing liquid shown in Table B-1 and that the vapors in the gas space above the liquid have reached equilibrium. It is assumed that the vapors are displaced as liquid is added to the tank at the maximum design flow of 8 gpm with no liquids being removed for processing.

The calculation of the VOC vapors in the influent tanks was made using Raoult's Law (Henley, 1959):

$$p_A \quad = \quad P_A x_A$$

where: p_A = partial pressure of compound A above the solution

x_A = mole fraction of A in solution

P_A = vapor pressure of pure A at the temperature of the solution

The following assumptions were made in the application of Raoult's Law:

1) At the low concentrations involved, even normally immiscible liquids act as if they are in solution.

2) At the very low concentrations involved, each VOC acts as if it were the only compound in solution.

Vapor pressure tables for the VOCs provide the boiling point temperatures at specific pressures. The following equation (derived from the relationship of vapor pressure and temperature log P = A - (B/T) (Perry and Green, 1984)) was used to interpolate the data on these tables to get vapor pressure at a given temperature (21° C).

$$\log (P/P_1) = \log (P_2/P_1) \times (T_2/T) \times (T - T_1)/(T_2 - T_1)$$

where: P = vapor pressure of interest

T = temperature of interest

P_i = vapor pressure at temperature T_i (from published tables).

Table B-2 shows the data used to calculate the vapor concentrations as well as the intermediate results obtained in the calculation of those concentrations.

Table C-1

	Source Concentrations			Weighted Averages							
				Average Processing Liquid Flows				Accident Scenario Liquid Flows			
Volatile Organic Chemical	Source Well (mg/l)	French Drain (mg/l)	Footing Drain (mg/l)	Source Well (gpm)	French Drain (gpm)	Footing Drain (gpm)	Weighted Average Conc. (mg/l)	Source Well (gpm)	French Drain (gpm)	Footing Drain (gpm)	Weighte Average Conc. (mg/l)
Carbon Tetrachloride	2.80 E+1[1]	8.30 E-1	0	5.00 E-2	2.00 E0	1.00 E0	1.00 E0	1.00 E0	5.00 E0	1.00 E0	4.59 E0
1,2-Dichloroethane	1.60 E+1	5.06 E-1	0	5.00 E-2	2.00 E0	1.00 E0	5.94 E-1	1.00 E0	5.00 E0	1.00 E0	2.65 E0
1,1-Dichloroethene	4.80 E+1	3.78 E0	0	5.00 E-2	2.00 E0	1.00 E0	3.27 E0	1.00 E0	5.00 E0	1.00 E0	9.56 E0
t-1,2-Dichloroethene	5.07 E0	1.25 E-1	0	5.00 E-2	2.00 E0	1.00 E0	1.65 E-1	1.00 E0	5.00 E0	1.00 E0	8.14 E-
Tetrachloroethene	1.32 E+1	1.09 E0	0	5.00 E-2	2.00 E0	1.00 E0	9.31 E-1	1.00 E0	5.00 E0	1.00 E0	2.66 E0
Trichloroethene	7.20 E+1	4.15 E0	0	5.00 E-2	2.00 E0	1.00 E0	3.90 E0	1.00 E0	5.00 E0	1.00 E0	1.33 E+

[1] 2.80 E+1 = 2.80×10^1 = 28

Table C-2

Volatile Organic Chemical	Liquid Conc. (mg/l)	Molecular Weight	gram-moles[1] per liter (gmoles/l)	liquid[2] mole-fraction	Vapor Pressure of Pure Chemical (mm Hg)	Vapor[3] Partial Pressure (mm Hg)	Partial[4] Pressure fraction	Vapor[5] Conc. (g/m^3)
Carbon Tetrachloride	1.00 E0	153.84	6.50 E-6[6]	1.17 E-7	91.15	1.07 E-5	1.78 E-8	9.00 E-5
1,2-Dichloroethane	5.94 E-1	98.97	6.00 E-6	1.08 E-7	68.66	7.44 E-6	1.24 E-8	4.03 E-5
1,1-Dichloroethene	3.27 E0	96.95	3.37 E-5	6.09 E-7	510.56	3.11 E-4	5.18 E-7	1.65 E-3
t-1,2-Dichloroethene	1.65 E-1	96.95	1.70 E-6	3.07 E-8	267.51	8.22 E-6	1.37 E-8	4.36 E-5
Tetrachloroethene	9.31 E-1	165.85	5.61 E-6	1.01 E-7	15.01	1.52 E-6	2.54 E-9	1.38 E-5
Trichloroethene	3.90 E0	131.40	2.97 E-5	5.36 E-7	62.85	3.37 E-5	5.61 E-8	2.42 E-4
Water	1.00 E+3	18.02	5.54 E+1	1.00 E0	18.69	1.87 E+1	3.12 E-2	1.84 E+1

1 gram-moles/liter = Liquid conc./(Molecular Weight x 1000 mg/g)

2 liquid mole-fraction = $\dfrac{(\text{gram-mole/liter})_i}{\sum (\text{gram-mole/liter})}$

3 Vapor Partial Pressure = Mole fraction in vapor = Vapor Pressure x liquid mole-fraction (Raoult's Law)

4 Partial Pressure Fraction = (Vapor Partial Pressure)/(Gas pressure above liquid = Atmospheric Pressure = 600 mm Hg)

5 Vapor Conc. = Partial Pressure fraction x molecular weight x (N/V)

N/V (from PV = NRT) = 32.82 gmoles/m^3

6 6.50 E-6 = 6.50×10^{-6} = 0.0000065

APPENDIX D - RISKS FROM EXPOSURES DURING INSTALLATION

Risks From Dermal Exposure During Drain Installation

Soil-borne organic chemical concentration[1]

Bis(2-ethylhexyl)phthalate:

Average[2] (used in chronic exposures)	2,740 μg/kg
Maximum (used in acute exposures)	7,214 μg/kg

Exposure period: 5 days/week for 12 weeks

Exposure dermal area[3]

Total body surface area		18,000 cm^2
Percent body surface for:	arms and hands	18%
	lower legs and feet	18%
	head and neck	9%
Assumed exposed skin surface		8,100 cm^2

$$U = \frac{C \times A \times S \times F \times 10^{-6}\ \text{kg/mg}}{M}$$

where:

U = Daily uptake of contaminant through the skin

C = Concentration of contaminant in the soil (μg/kg)

A = Amount of soil adhering to skin = 1.5 $mg/cm^2/day$

S = Exposed skin surface = 8,100 cm^2

F = Fraction of contaminant absorbed through skin = 0.07

M = Body mass of adult = 70 kg

U_{avg} = 3.3 E-5 mg/kg/day

U_{max} = 8.8 E-5 mg/kg/day

Carcinogenic Risk = U_{avg} x Risk Factor x Exposure Duration Adjustment

Risk Factor = 6.84 E-4 $(mg/kg/day)^{-1}$

Exposure Duration Adjustment = $\frac{\text{duration of exposure}}{\text{average lifetime}}$

= $\frac{60}{70 \times 365}$

= 2.35 E-3

Carcinogenic Risk = 5.3 E-11

Non-carcinogenic

Acceptable Chronic Intake (AIC)[4] = 2.00 E-2 mg/kg/day

Ratio of U_{max} to AIC = 4.40 E-3

1 Unless otherwise identified, all data and analysis methods are obtained from (Rockwell International, 1988b).

2 During calculation of averages, when results were less than the minimum detectable levels of analysis, a value of 1/2 the minimum detectable level was used.

3 Shleien, 1984.

4 See Appendix B, Specific Risk Estimation Terms.

Exposures To Uranium From Excavation Of Localized Radioactive Contamination

Effective air contamination levels can be calculated from the following equation:

$$C_A = C_s \times L_d \times K$$

where:

C_A = Effective air contamination (μCi/ml)

C_s = Average soil concentration (μCi/gm)

L_d = Average airborne dust loading (mg/cubic meter)

K = Units conversion factor

$$10^{-9} \frac{gm - m^3}{mg - ml}$$

This may be solved for C_s:

$$C_s = \frac{C_A}{L_d \times K}$$

If C_A is set at 1×10^{-10} μCi/ml[1] (the Maximum Permissible Concentration for occupational exposures to insoluble[2] uranium 234, 235, or 238) and L_d is set at 10 mg/m^3 (the OSHA limit for nuisance dusts), then

$$C_s = 0.01\ \mu Ci/gm = 10{,}000\ pCi/gm$$

The most conservative dispersion factor (leading to the highest offsite concentrations) used for the 881 Hillside area is 1.5×10^{-4} sec/m^3 at 1 meter per second wind speed. At that wind speed, to maintain a 10 mg/m^3 dust loading over a cross-sectional area four meters high and ten meters long[4] would require generating dust at the rate of 400 mg/sec. The air concentration of the closest offsite location is calculated by the following equation:

$$C_A = S \times C_s \times X/Q \times K$$

where C_A, C_s, and K are as before,

S = Source term or rate of dust generation (mg/sec)

X/Q = dispersion factor (sec/m^3)

if C_s = 0.01 μCi/gm

X/Q = 1.5×10^{-4} sec/m^3

K = $10^{-9} \dfrac{\text{gm - m}^3}{\text{mg - ml}}$

S = 400 mg/sec

then $C_A = 6 \times 10^{-13}$ μCi/ml

The Maximum Permissible Concentration in air in unrestricted areas for insoluble uranium 234 or 235 is 4×10^{-12} μCi/ml[3] and for uranium 238 is 5×10^{-12} μCi/ml[3].

1 Code of Federal Regulations, Title 10, Part 20, Appendix B, Table I, Column 1.

2 All calculations assume insoluble rather than soluble uranium since any soluble forms would have been removed from the soil surface by natural processes.

3 Code of Federal Regulations, Title 10, Part 20, Appendix B, Table II, Column 1.

4 This cross-sectional area was chosen as a conservative estimate of the largest dust cloud likely to be stirred up during an excavation as considered here.

APPENDIX E - REFERENCES

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